Department of Public Instruction

VOCATIONAL PUBLICATIONS

Vocational Series No. 10

Pre-Vocational Agricultural Courses for the Public Schools of Indiana

INDIANAPOLIS, INDIANA
April, 1915

Department of Public Instruction

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Bulletin No. 15 Vocational Series No. 10

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FOR THE

Public Schools

OF

Indiana

INDIANAPOLIS, INDIANA
April, 1915

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Department of Public Instruction

VOCATIONAL DIVISION

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CONTENTS.

EXPLANATION OF COURSES OF STUDY.

The Indiana Vocational Education Law makes it obligatory on the State Board of Education to make out courses of study in agriculture for the seventh, eighth, and high school grades, which courses are "to be followed as a minimum requirement." Teachers are expected to use the courses herein outlined as provided for under the law.

Seventh and Eighth Grades.

The following courses have been prepared with a full knowledge of the fact that a teacher who can give but two periods per week to the work in the seventh and eighth grades can not cover all the work outlined. Due consideration has been given to the fact that all communities are not alike and that the same phase of the subject of agriculture should not be given equal emphasis in all communities. The courses have been made broad and elastic enough to meet all conditions. The work should be uniform for a given county. The county superintendent should notify his teachers as early as possible as to which phase or phases of the subject will be taken up in the county. It is advisable for the schools that can give but two periods per week to agriculture to limit their work to soils, or crops, or horticulture, etc. It may be advisable in some counties to make the township the basis for uniformity. Schools that can give five forty-minute periods per week to the subject are expected to do so. In such schools practically all of the work outlined for seventh and eighth grades can be covered during the year.

Two years work has been outlined for seventh and eighth grades in schools that give full time to the subject. Seventh and eighth grade pupils can take the work together. All of the work outlined can not be covered by schools that give only two periods per week to the subject.

The work has been arranged in seasonal sequence. No doubt there will have to be variations from the given order from time to time to meet conditions that may arise in given communities.

High Schools.

The high school work is outlined in half-year courses. Two of the courses are required for one year's work. Schools that wish

to retain their commissions or certificates are expected to conform to the law and follow the state course of study as a minimum requirement. A course in agricultural botany does not answer the requirements of the law.

Text-books.

Text-books should be used for reference purposes only. It is a grave mistake to adopt a text as a basis for the work in either the seventh and eighth or the high school grades. Lack of interest on the part of the pupils and less efficiency on the part of the teacher result from a text-book treatment of the subject of agriculture.

Not one book but several different books should be used. The class should be divided into groups of two or more and each group should buy a different book from those purchased by other groups.

Use of Land.

It is not necessary that the school own land to be managed and cultivated by the pupils. The home farms should be drawn upon chiefly for land to be used in connection with the school agricultural work. This does not mean that the father must set aside a piece of land to be used by his boy exclusively and in such a manner that the father will not realize his regular income therefrom. The project work should be organized in such a manner that the boy can do the regular routine of work assigned by his father but at the same time give intelligent and careful attention to one particular phase of the work as, for example, corn growing, pig raising or gardening. Without the home project work during both winter and summer the school agricultural work is in most cases meaningless and to a large degree worthless.

Supervision of Summer Project Work.

A good teacher of agriculture should be employed in each township for a year of twelve months. His business during the summer would be to supervise the home project work. Such supervision is necessary to the accomplishing of desired results.

Collaborators in the Preparation of the Courses Herein Outlined.

The courses outlined in this bulletin were prepared under the direction of the State Supervisor of Agricultural Education.

Members of the faculty of Purdue University and a committee of the Indiana Agricultural Teachers Association coöperated in the work as follows:

Soils:

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Supt. J. W. Foreman, Petersburg.

Farm Mechanics:

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History and Civics:

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Z. M. SMITH,
State Supervisor of Agricultural Education.

COURSES OF STUDY.

Soils.

SEVENTH AND EIGHTH GRADES, 1915-1916.

September, 1915.

Soil Types.

I. Material and Equipment—

Samples of clay, loam, and sandy soils, muck, a hand lens for each pupil, pans or heavy paper on which to place samples of soil. Note book for each pupil.

II. Method of Procedure—

a. Demonstration Exercises:

Have pupils secure samples of four particular kinds of soil—sandy, clay, loam, muck.

Other samples should be secured in the community by the teacher if possible and studied in class room for further identification.

Examine with the fingers and note differences in the grittiness of these different types.

Explain the reason for the differences in texture and color.

Study under a hand lens each type and note differences in size, shape and arrangement of particles.

b. Home Projects:

Each pupil should make a diagram of the home farm and mark on the diagram the location of the garden, and the field or fields to be used for wheat, corn, and alfalfa. The samples of soils to be used in the laboratory during the year should be secured by the pupils from these fields and gardens.

Pupils should study the formation of soils as now taking place in these fields and gardens.

III. Points of Information—

All soils except muck or peat are derived from the breaking down and decomposition of rocks. This breaking down and decomposition leaves the rock particles of various sizes. When the particles are rather coarse so that they can be

easily felt and seen, they are called sand, and a soil made up largely of such particles is called sandy soil. When the particles are so small that they seem like powder, the soil which they make up is called clay or clayey. When fine and coarse particles are about evenly mixed, the soil thus formed is called loam. Muck or peat soils are derived from a decay of plants in swamps or shallow lakes. These soils are the accumulation of ages of growth and decay. The mass of the soil is almost entirely vegetable matter, but it contains more or less of rock particles which have been washed in to the depressions from which the muck has been formed.

There are several agencies which help in the formation of soils. Water is perhaps the most active agent. When it soaks into the rock and is frozen, it has a tendency to break the rock into particles. When it runs over the rock surface or rolls rock particles over each other, there is a wearing away of the rock particles into smaller particles. When ice and snow accumulate into a glacier and move over the surface of the earth there is a grinding and crushing of the rock particles until they are so fine that when the glacier melts they remain behind as soil. Quick changes of temperature in some parts of the world affect rock particles in such a way as to burst them apart. The throwing out of the dirt from burrows by burrowing animals is also an agency in the formation of soils.

The different kinds of soils mentioned above have different properties of weight, color, temperature, size of particles, power of retaining moisture, etc. These properties are called physical properties. Two words are used in connection with physical properties which should be thoroughly understood. The term "texture" refers to the character of the particles whether they are fine or coarse. The term "structure" refers to the arrangement of these particles in crumbs. In sandy soils there is practically no structure because the particles do not stick together, but in loams and clay soils the particles stick together easily and have crumbs of various sizes. Large crumbs are called clods.

October, 1915.

Weight of Soils.

I. Material and Equipment—

One gallon buckets or cigar boxes, pair of either spring or balance scales, one gallon of each type of soil.

II. Method of Procedure—

a. Demonstration Exercises:

Weigh a measured quantity of the different types of soil.

Calculate the weight per cubic foot of each type.

How does the structure of good soil affect the weight?

Explain why sandy soils are considered "light."

What effect does organic matter have on the actual weight of a soil?

b. Home Projects:

The samples of soils should be those collected from the home fields and gardens. Plans should be made for adding organic matter to the clay and sandy soils in the gardens and in the fields to be used for corn or alfalfa.

III. Points of Information—

Soils are usually spoken of as being "heavy" or "light." These two terms do not refer to the actual weight of the soil in pounds, but to the ease of cultivating. Soils which contain a good deal of sand are called light soils because they are easy to plow and cultivate and never produce clods. Soils which have a large amount of clay material and not much vegetable matter in them are spoken of as heavy soils. These soils, when they are dry, form hard clods and are difficult to plow and cultivate. Light soils, being sandy, usually drain quickly and warm up early in the spring and are adapted to early crops like vegetables. Heavy soils drain more slowly and do not warm up so quickly and are better adapted to summer crops like corn.

In actual weight sandy soils are the heaviest and muck or peat soils lightest. Loams and clay soils are medium weight. Sandy soils often weigh as much as 100 lbs per cubic foot, while garden loam soil will not weigh more than about 70 lbs. The amount of vegetable (organic) matter in

the soil not only affects its actual weight but also affects the ease with which it can be tilled. The more organic matter, the lighter its weight and the easier it is tilled.

November, 1915.

Porosity of Soils.

I. Material and Equipment—

One half gallon of each type of soil thoroughly dried and pulverized, bottles with bottoms removed, racks for bottles, four glass tumblers, one graduate.

II. Method of Procedure—

a. Demonstration Exercises:

Remove the bottoms from four quart bottles and make a rack for holding these inverted. Fill each with a given amount of each of the four soils. Add a definite amount of water simultaneously to each of the four bottles and note time necessary for the water to percolate through the soils in each bottle.

Note total amount of water each percolates from the time the first drop falls until dripping ceases.

Compact sand and clay soils in these bottles for a second phase of the exercises and add a definite amount of water as before. Take readings and compare with the first part of the exercise.

Why does the water percolate faster through sand than clay soil?

Does compacting affect the rate of percolation in sand? In clay? Why? What effect does the soil type have upon drainage requirements?

b. Home Projects:

The pupils should make a study of the soils and drainage conditions in the home fields and gardens. Does the water percolate down through the soil after a rain or does it pass away over the surface to a great extent? Plans should be made to improve the porosity of soils through which the water will not percolate.

III. Points of Information—

If a tumbler be filled with shot, it can easily be seen that there are spaces left between the particles. If shot are of different sizes, the spaces will be different. If the tumbler be filled with shot of various sizes, the nature of

the spaces will be still different. These different sized shot may be used to represent the different sized particles that go to make up the soil. When these different sized particles of soil are massed together, there are spaces left between them. These are called pore spaces. Now the pore spaces in the soil are influenced not only by the size of the particles making up the soil, but by the amount of organic matter in the soil and the way in which the soil is compacted. A loose soil will have more pore spaces than a compact soil.

A soil which has large pore spaces takes up rainfall very quickly while one with small pore spaces allows a dashing rain to run off its surface before it can soak it up. It can be seen, therefore, that a sandy soil, which has large pore spaces, will absorb a rain quickly and let it percolate down through its mass without much resistance, but in the case of a clay soil, the pores are so small that the water cannot enter readily and a great deal of the rainfall will run off the surface and such as does enter the soil will percolate slowly, due to the small sized pores. Thus it can be seen that a sandy soil does not require much tile draining, while a clay or loam soil will require more drainage.

December, 1915.

Physical Effect of Lime on Soils.

I. Material and Equipment—

One quart of clay soil.
One-fourth pint of slaked lime.
Two 8-inch test tubes or two long olive or pickle bottles.
Two tin pie pans.
One tablespoon, one teaspoon.
One-fourth pint of decomposed, pulverized organic matter.

II. Method of Procedure—

a. Demonstration Exercises:

1. Add a tablespoonful of lime to a half pint of clay soil. Mix with water to the consistency of a thick batter. Mix another half pint of clay soil to the consistency of a thick batter, without adding lime. Have both samples equally wet. Dry both samples thoroughly and note which can be pulverized most easily. With a half pint of clay soil mix one-fourth pint of organic matter. Make a batter. Does this sample

crumble as readily as the sample containing lime? Would it be advisable to add either organic matter or lime to heavy clay soils? Why? Which would be better for permanent improvement? What is an economical way of adding organic matter to soils?

2. Fill each of the test tubes or long small bottles with water. Into each container put one tablespoonful of clay soil. Into one of the containers put one teaspoonful of lime. Shake each container vigorously. Set them aside and note results. In which does the water clear up first? Why?

b. Home Projects:

Have the pupils study with their parents the clay soils to be used for growing corn or vegetables. If these soils need organic matter, provision should be made for supplying it. If organic matter cannot be supplied, lime should be used. Care must be taken in applying lime, because there is danger of burning out the organic matter already in the soil.

III. Points of Information—

Under the natural conditions the soil particles cling together and form crumbs of varying size. It is this crumb structure of the soil which, when it is plowed and cultivated, at proper moisture conditions, makes the soil mellow and easily pulverized. A soil which has good crumb structure is easily drained because the water finds it easy to move downward through the soil to the tile. Of course in sandy soils we find no crumb structure, but most of the loam soils and the better clay soils have a good crumb structure which enables them to permit drainage to good advantage.

Where the soil lacks good crumb structure it is possible to bring about a better condition. Two or three things are necessary to do this.

1. The ground should be plowed and cultivated only when the moisture condition is right. This condition can be determined only by the farmer who is handling the particular soil.

2. The introduction into the soil of organic matter in the form of stable manure or green manure will have a tendency to improve the crumb structure.

3. The application of lime to the land will have a decided

effect upon its flocculation. One can observe the effect of lime by taking a teaspoonful of soil and stirring it thoroughly in a pint of water, then putting in about a teaspoonful of lime and stirring it thoroughly and letting it settle. If observed closely, it can be seen that the particles of soil are settling in little flakes or floccules. The lime has a tendency to bring the individual particles together into little flakes. A similar action takes place in the soil when lime is applied. If lime is applied to the land for the purpose of influencing its granulation, as much as two tons to the acre should be used.

January, 1916.

Physical Effect of Organic Matter on Soils.

I. Material and Equipment—

One half gallon of clay, one half gallon of muck, six small tin or galvanized troughs, 1 pint of lime.

II. Method of Procedure—

a. Demonstration Exercises:

Make a batter of clay soil. To one-half of the batter add one-half as much muck soil. Mix thoroughly. Fill a small tin or galvanized trough with the batter of clay and dry thoroughly. Do the same with the mixture of clay batter and muck. Remove from the troughs and note how much more easily the sample containing muck may be crumbled than the sample without the muck soil added.

Repeat exercises, using lime instead of muck. Would it be advisable to add organic matter or lime to heavy clay soils? Why?

Suggest an economic way of introducing organic matter into soil.

Explain the effect of the lime in this exercise.

b. Home Projects:

If there are plots of clay soil in the gardens, or the fields to be used for corn or alfalfa, plans should be made for supplying organic matter to be plowed under. Pupils should report on information obtained from parents and neighbors as to their experience in plowing under clover, alfalfa, rye, cowpeas, or soy beans.

III. Points of Information—

The term organic matter refers to any body which has or has had life. When speaking of the organic matter in relation to soils, we refer to plant bodies. The decay of plant bodies or vegetable matter in the soil is highly beneficial to the physical character of the soil and to the production of crops. Where there is a good deal of organic matter in the soil, the land will plow easily, hold moisture well and be easy to cultivate. The decay of the organic matter also adds plant food to the soil.

Organic matter can be added to the soil in the form of manures from the stables or sheds, or, by plowing under green crops of rye, clover, cowpeas, soy beans, etc., or, by the plowing under of the stubble which remains from a previous crop residue. Perhaps the best method of getting organic matter added to a large area in a uniform way is to plow under a green crop. Few farmers have enough stable manure to cover a large area.

February, 1916.

Drainage.

I. Material and Equipment—

Four tomato cans, clay, sandy and loam soils (1 quart each), muck, radish, lettuce, or clover seed.

II. Method of Procedure—

a. Demonstration Exercises:

Demonstrate the bad effects of free water on plant growth by planting seeds in soil which in one case is kept saturated with water and in another where only enough water is added to keep the soil nicely moist.

A couple of old tin cans filled with soil will answer very well for this exercise. Punch holes in the bottom of one to afford drainage and leave the other without. In which case do the seeds germinate most readily? After standing for sometime, note the relative conditions in the plant growth. Why these conditions? Explain the effects of drainage.

b. Home Projects:

Have pupils observe growth of crops over or near tile drains and compare with growth of crops on undrained areas.

Have pupils plan a system of drainage for the undrained fields at home. Have them draw plans of the tile drains that have been laid in the fields at home.

III. Points of Information—

By drainage is meant the removal of the surplus water from the soil. This may be done either by means of open ditches or by means of tile drains. There are several reasons for draining the land.

1. The land is ready for tillage earlier in the spring.
2. Larger yields are produced.
3. The quality of the crop is better.
4. The land is easier plowed and cultivated.

Drainage also affects the temperature, aeration, moisture and available plant food in the soil. Well drained lands have a higher temperature than soils that are not drained, consequently a well drained field can be planted earlier in the spring than an undrained field. Where the land is drained the air has a chance to get into the soil and aerate it. This aeration will furnish better conditions for the growth of the plant roots and helps to make the elements of plant food available. In a drained field the roots of the plants can extend throughout a larger volume of soil and thus come in contact with a larger amount of plant food and moisture and consequently the plants will thrive and withstand dry weather better than on undrained land. The fact that the roots can grow throughout a larger volume of soil enables the plants to have a larger supply of moisture for the dry seasons.

The depth to which land should be drained varies somewhat but it should be drained deep enough so that the roots of the plants may have three feet or more of soil to grow in.

March, 1916.

Seed Bed Preparation.

I. Material and Equipment—

Four lamp chimneys, two gallons of sandy soil, some fine clods, one pint of wheat chaff, one quart of loam, four shallow pans or one long pan.

II. Method of Procedure—

a. Demonstration Exercises:

Demonstrate the effect of plowing under cloddy soil or large amounts of undecayed organic matter, on the

rise of capillary water. Also the effect of disking organic matter into the surface soil before turning under. Use four lamp chimneys, numbered 1, 2, 3, and 4. Fill all to a depth of five inches with a sandy soil. Finish filling No. 1 using good loam soil. On top of the sand in No. 2 put one inch of wheat chaff well packed down. In No. 3 put two inches of fine clods. Finish filling Nos. 2 and 3 with loam soil. Complete the filling of No. 4 by using a mixture of loam and the same amount of chaff used in No. 2. Set all chimneys in about one inch of water. Observe and explain results.

b. Home Projects:

The pupils should follow instructions carefully in the preparation of the seed beds for their home project work with corn, alfalfa, or vegetables.

III. Points of Information—

If conditions are favorable it is advisable to plow your ground in the fall, especially in the northern part of the state. The frost will help to mellow it. Ground that will puddle or ground that will wash during the winter, should not be plowed before spring. Spring plowing should be done as early as possible. The depth of plowing should be determined by the character of the soil, and, to some extent, by the previous crop. Double disk the land before plowing to insure the most thorough pulverization of the whole furrow slice, and so that large air spaces may not be left underneath.

The ground should be thoroughly pulverized. Make the seed bed for your corn as good as the expert gardener makes for his garden seed.

April, 1916.

Commercial Fertilizers.

I. Material and Equipment—

Samples of different kinds (not brands) of commercial fertilizers, tomato cans.

II. Method of Procedure—

a. Demonstration Exercises:

Study the characteristics of the different kinds of fertilizers until the pupil can recognize each kind by sight, taste or smell. Many of the large fertilizer man-

ufacturers will furnish samples in small bottles at cost of transportation.

Fill two tomato cans with muck. Mix a small amount of potash with one sample before filling the can. Plant seeds in the muck. In which do the seeds germinate better and in which do the plants grow better?

Use samples of different kinds of fertilizers on clay and loam soils.

b. Home Projects:

Make fertilizer tests on soils in the gardens and fields at home. For this purpose use plots about 1 rod wide and eight rods long. Leave an unfertilized space of about three feet between each plot. The diagram that follows shows the arrangement of the plots and the kind and quantity of fertilizing material to be used. This may be varied, of course.

(See Vivian, pages 226-227).

No Fertilizer.
15 lbs. Nitrate of Soda. 15. lbs. Sulphate of Potash. 30 lbs. Acid Phosphate.
30 lbs. Acid Phosphate. 15 lbs. Sulphate of Potash.
No Fertilizer.
15 lbs. Nitrate of Soda. 15 lbs. Sulphate of Potash.

2—3385

15 lbs. Nitrate of Soda. 30 lbs. Acid Phosphate.

No Fertilizer.

III. Points of Information—

Do not attempt to build up your soil by the use of commercial fertilizer alone. If used in connection with the rotation of crops, drainage, legumes, and manure, a formula containing ten per cent. available phosphoric acid and two to five per cent. potash is recommended. Two hundred pounds per acre may be applied when planting the corn by distributing it along the entire row with a fertilizer attachment on the planter. If heavier applications are to be made they should be made with a wheat drill before the corn is planted.

Crop rotation is necessary to soil improvement. Plan to have for your corn ground a field having produced a legume the year before. *Corn should not follow corn*, as a rule.

Manure is excellent material for soil improvement. This may be applied at the rate of from 10 to 15 two-horse wagon loads (10 to 15 tons) per acre. It should generally be applied before plowing and the land disked so as to somewhat mix the manure with the surface soil before plowing it under. If applied after the ground has been plowed, it should be thoroughly worked into the soil before the corn is planted. Reinforce each ton of manure with 50 pounds of acid phosphate (14%), which may be spread on the top of each load and spread on the ground along with the manure. This treatment will render the use of large amounts of mixed fertilizer unnecessary.

CROPS.

Seventh and Eighth Grades.

September, 1915.

CORN—SEED SELECTION.

Material and Equipment—

1. As many types of racks for drying seed corn as you can devise or find. Other methods of caring for corn as hanging from rafters, etc.
2. A few stalks that are as near the ideal as possible, before visiting the field.
3. Some good seed ears.

Demonstration Exercises—

1. Go into the field and study types of stalks and ears. This may be preceded by a laboratory period in the school.
2. Gather ears for seed and use racks and other devices for hanging to dry.
3. Compute area planted by one good ear of corn.

Points of Information—

Seed corn may be selected (1) early in the fall before it freezes, usually in September or October. (2) At the time of husking by having a box or bag for the best ears. (3) In the spring from the crib.

All three methods are practiced but with different results. The first method has several advantages over the other two. The corn should not be left to freeze in the field and the stalk should be considered in making the selection. The work is of sufficient importance, as may be seen by Exercise 3 above, to give one's whole attention to the matter, which is not possible at husking time.

In selecting the corn, consider the following points: (1) The ear should be from a stalk standing erect. (2) The ear should hang about midway of the stalk at convenient height for husking. (3) The ear should point slightly forward, not downward nor straight up. (4) Seed corn should be selected from stalk growing under normal conditions, by which we mean that when a stalk produces a better ear than those about it, and no good reason can be assigned, it is probably one of more inherent merit than where unusual space or excessive

fertility explains the good ear. (5) Finally the ear should be so suspended that it will get a good circulation of air and should not be subjected to extreme heat or cold. Dry cellars, basements or attics, if free from mice and rats, may be used for storing corn. The use of screen wire to keep away mice and rats, and moth balls or naphthalene to protect from grain moths, is recommended when the corn is finally stored for the winter.

October, 1915.

CORN—HARVESTING.

Material and Equipment—

1. A stalk of corn with ear or ears.

Demonstration Exercises—

1. Inspect a field being hogged off to note the amount of waste.
2. Inspect the harvesting of corn as silage.
3. Study the amount of plant food lost by letting corn stand in field.
4. Inspect the corn being harvested in shocks. Measure and calculate difference in surface area between large and small shocks. Why make large shocks?
5. Examine corn in field and in shock at this date to note degree of dryness. Is it dry enough to crib?

Points of Information—

1. Husking from the standing stalk is the most common and most wasteful method of harvesting corn, but it is probably the most economical of labor and time and permits larger areas of corn than any other method. Little use can be made of the stalks, and such use as is made by pasturing the stalks is not economical of feed or live stock. Some experiments have been made as to making silage from the dried stalks, which would make such feed more palatable. It may be that such a waste as this keeps the farmer from making money or it may be that the labor saving feature is making the farmer money, depending upon the situation. Discuss this point in class. With higher priced land and more complex industrial conditions the farmer is being forced to change his methods of corn harvesting.

2. The second method of harvesting most used is cutting and shocking the corn. This is done when the lower leaves and husks show signs of ripening. Why is there greater waste of feed in small shocks than large ones? Are the dried stalks regarded as feed of high quality? What change of method in harvesting does this suggest?
3. The soiling method is cutting and feeding the corn while green. This is done just after the roasting ear stage and makes use of more of the stalk.
4. Hogging off corn is coming into greater use every year and is recommended by the results from several experiment stations as economical. It is best to use fences and pasture a small area at a time. Twenty to twenty-five hogs per acre is about the best number. Begin about September 1. Dry autumns are more favorable for this method than wet autumns. The economy is in having the hogs do the harvesting, leaving the stalks and fertilizer distributed over the field.
5. Siloing has three advantages.
   a. Saves entire crop.
   b. Enables farmers to handle larger number of live stock.
   c. Convenient method of handling the crop. No more work to put in silo than in shock.

November, 1915.

CORN—SHRINKAGE.

Material and Equipment—

1. Ears of corn from field, some dry ears from last year's crop.
2. A pair of balances, or spring scales, if the former is not available.
3. A tapeline.

Demonstration Exercises—

1. Get ears of corn from the field. Weigh at once. Hang up and let dry. Weigh again after three or four weeks.
2. Measure accurately the length and circumference of the ears when gathered and again after drying for three or four weeks.

3. Get a quart of shelled corn from the elevator or home. Weigh, dry by the furnace for a few days and weigh again.
4. Calculate the percentage lost in weight in several of the tests above and determine the comparative prices of corn held through the winter.

Points of Information—

Some careful experiments have been made to determine if any definite data could be given out regarding the percentage of shrinkage, but different seasons and soils and strains of corn make considerable fluctuation. Bowman and Crossley indicate that an average of 16% between November and March for usual conditions could be used as a basis for computation at least. The breeders of different kinds of seed corn will often give some good data in their advertising circulars. This shrinkage is due to the presence of moisture that disappears slowly until the minimum is approached in the following summer. To be sure, the shrinkage continues very slowly a second or even a third year but is of little consequence. At the Iowa Station the shrinkage was greatest in November, and then with little loss until March. The shrinkage for that month, April and May are the high months for the year. After November the practical side of this work is evident when we compare price quotations for a few years, and the question that comes to the farmer is when to market his corn.

December, 1915.

PURITY OF SEEDS.

Material and Equipment—

1. Samples of clover, alfalfa and timothy seed.
2. Any weed seed collection available, or get a few buckhorn, pigweed and other common seeds that may be identified. This should be provided in the fall months.

Demonstration Exercises—

1. From one hundred clover or other seeds count the weed seeds and determine percentage of purity.
2. Put 200 pure seeds to germinate to see what percentage will grow.

Points of Information—

The importance of good seed should be impressed. It is fundamental as the source of the new crop. It should contain vitality; it should be free from weed seeds and other foreign material; it should be true to name, free from disease and well bred. There are many things, we see, to be considered. It will be seen from Exercise 1, above, that farmers sow every spring very many weed seeds with their grass seed. By purity of seed we mean only that the seed be free from foreign material, but it is a good time to impress the importance of good seed as well.

January, 1916.

CLOVER.

Material and Equipment—

1. The teacher should have dried specimens of as many kinds of clovers as are obtainable, such as Little Red, Mammoth, White, Alsike, Crimson.
2. Get seeds of each kind of clover from a grain dealer.
3. Metric scale.
4. Small lens.

Demonstration Exercises—

1. A simple drawing of the root system should be made of each plant.
2. With the metric scale and under the lens measure each different kind of seed and record. Make drawing of same and note the characteristic color.

Points of Information—

A brief description of each kind of clover should be had. This may be found in many places but Purdue Extension Leaflet 31, Chapter XIII of Fisher and Cotton's Agriculture for Common Schools, Wilson and Warburton's Field Crops, Chapter XVIII, will be found satisfactory. Note the kind of soil, preparation of seed bed, use of nurse crop, etc. Note that some clovers like Little Red are biennial, while the White and Alsike are perennial and the Crimson is an annual. What effect would that have upon their use in a rotation?

Discuss why the red clovers are most common. Note the differences in quantity of seed and the price of same.

Emphasize the need of clover and its use as soiling crop and soil builder. Does alfalfa take the place of clover?

February, 1916.

ALFALFA.

Material and Equipment—

1. About the same as in the clovers. Have some dried specimens and some seed. If possible get some sweet clover specimens and make comparison.

Demonstration Exercises—

1. Study the root system of the alfalfa and compare with the clovers.
2. Make the test for purity of seed as done in December, also the germination test.
3. With the metric scale and lens study and measure the different shapes of seeds and note color.

Points of Information—

There is a great abundance of material in books, agricultural papers, pamphlets and bulletins upon alfalfa. Enough should be secured to get an idea of the general importance attached to this crop. Note its perennial character, its value as a silo builder, its importance as a hay crop or cash crop. Learn the quantity of seed to sow and where it is best to get the seed. Let some pupils get the opinions of some of the local farmers who have tried the crop.

The important things to consider are (1) Seed bed preparation. (2) Liming the soil. (3) Inoculation. (4) Plant food. (5) Kind of seed. (6) Time of sowing. (7) After treatment.

March, 1916.

CORN—GERMINATION.

Material and Equipment—

1. The seed corn gathered in the fall.
2. A rectangular box tester and as many other kinds of testers as can be secured.

Demonstration Exercises—

1. Review the exercises in September on Seed Corn Selection.

2. Make tests of the corn gathered in the fall.
3. Make tests of corn for farmers.
4. Calculate the loss in yield when one bad ear is used in planting one acre.

Points of Information—

The opening of spring is a very busy season for the farmer. He cannot afford to make an individual ear germination test unless it is shown to be important. What evidence can you bring to bear upon the question? Can he have this work done before the season opens? Has there been any change in the general practice of farmers as to making the ear test? One may get some information by testing a few ears that farmers have passed upon favorably by the method of examining the germ as to color, etc. A good description of a germination box is given in Wilson and Warburton, pp. 68-70, in Purdue Bul. 110, and other places. Show the pupil that weak vitality as brought out in the germination test is little better than no vitality.

The emphasis should be placed upon the relation of good seed to yield. Yield means results, the object of all the effort. If a little time in the spring devoted to the individual ear test counts appreciably toward greater yield in the fall, then it is worth knowing and worth practicing.

April, 1916.

CORN—SEED BED.

Material and Equipment—

Access to at least one type of corn planter.

Plowed land in different stages of preparation.

Demonstration Exercises—

1. Visit one field that was fall plowed and compare with fields recently plowed.
2. Get ears of corn representing different sized grains and by means of planter plates show necessity of grading corn and adjusting plates to size of kernels.
3. Have reports made by each member of class on the steps taken at home to get the seed bed prepared.

Points of Information—

Fall plowing for corn gives the soil a chance to mellow and decay. It aids in time saving in the busy spring

season. If the soil is inclined to run together or wash away, spring plowing is the better.

Since the ground is apt to be easily puddled by tramping at this season, care must be exercised in saving as much trampling as possible. Some soils once puddled require several years to recover their proper granular condition.

Care should be exercised that the plowed land should not be allowed to crust over and lose by evaporation much of the supply of moisture. This is true especially of the fall plowed land.

The seed bed for corn should not be loose but firm, well pulverized not merely on the surface but by disking and harrowing should be made in good condition throughout the furrow slice.

Farmers always like a clover sod for corn because the legume has left nitrogen in the soil. No fixed rule can be given for fertilizing, but barnyard manure has no substitute. This manure when mixed with raw rock phosphate is more complete. Complete commercial fertilizers are often used in various ways. Probably the application along the row is growing in use. Bowman and Crossley in their book "Corn" give much valuable help in describing tools and discussing this subject.

ANIMAL HUSBANDRY.

Seventh and Eighth Grades, 1915-1916.

Outline for Years Work:

A. Importance of Live Stock—
   a. Shown by interest taken in stock at fairs, etc.:
      1. International Live Stock Show at Chicago.
      2. Indiana State Fair at Indianapolis.
      3. County Fair in your own county.
      4. Colt Shows, Horse Shows, Street Fairs, Poultry Shows, etc.
      5. Boys' Judging Contests.

         Objects and purposes of these Fairs.

         Good results from visiting such exhibitions of animals.

b. Economic Value of Live Stock in the U. S. and in Indiana.
Number and Value of:
1. Horses and Mules.
2. Beef Cattle.
3. Dairy Cattle.
4. Sheep.
5. Hogs.

These figures may be obtained from the U. S. Census of 1910. Compare these figures with the same for corn, wheat, oats, hay, manufactured products, etc. Rank the different states according to numbers and value of each class of livestock.

How does Indiana compare with the other states? Compare Indiana with these others in area.

c. Tabulate the general uses of farm live stock to man.
1. Use for clothing.
2. Use for food.
3. Use for labor.
4. Use for maintenance of soil fertility.

September, 1915.

Livestock Census—

Outline of Study—

Explain carefully just what is to be done in the demonstration exercise.

Demonstration Exercises—

Have each pupil make an inventory of the number of horses at home 2 years old and over, the number 1 and 2, the number of colts, or those under 1 year, and the total number of all ages. Have the same done for cattle, sheep, and swine.

Have each pupil make an inventory of all the farm feeds produced and fed at home.

Tabulate these animals according to their use to man as given in the outline above. Make an estimate of the value of each. Include size of farm in acres, (a) of cultivated land, and (b) of permanent pasture.

Compare the number of horses used on the different farms per unit of area. Discuss the number of horses required to farm 40 acres of corn, 40 acres of oats or wheat, and 40 acres of clover. Make this a home exercise and require the figures to be obtained from the father of the pupil. This should open up a line of study

of requirements for farm power. Do some farms carry more or less than a sufficient number of horses to do the farm labor?

October, 1915.

Make a study of the farms represented in the school to find out what special forms of live stock raising are carried on. Some farms will be specializing in hogs or sheep or beef cattle or dairy cattle or horses. Find out whether some of the pupils are interested more in one class than another. Have pupils prepare an invoice of these farms, and if possible visit them. Study the equipment, necessary breeds used, and note any differences in the character of these farms as to lay of the land, etc. Have these farms taken up such specialized work because of the character of the farm or has the personal liking of the owner decided the matter?

November, 1915.

Begin the detailed study of animals. Have each student draw from picture, first, a hog. From score card supplied by Purdue University, locate the different parts. Learn these parts.

Draw another pictue of a hog and locate the different cuts of meat. Tabulate their comparative value and learn why some cuts are more valuable than others. Verify these facts by a visit to a local butcher shop. See Purdue Cir. 29.

Study the score card in Cir. 29 on fat hogs. Why is a larger score given to some parts than others? Describe the back of an ideal hog. Describe the form of a fat lard hog, a bacon hog.

December, 1915.

a. Have each pupil select the best hog on his father's farm and score it. Have pupil list the parts of that hog that fall short of being perfect. Make some exchanges by which one pupil will be enabled to score several of these same hogs and discuss these separate scores in class. These should be home tasks and reported to teacher and class.

b. Study the use of the different parts of the hog as classified by the butcher:

Side for bacon.
Hams, cured or fresh.
Loin, for chops.
Back, for chops.
Shoulder, same as ham.

Feet, pickled.

Waste (blood, lungs, entrails, etc.), for blood, meal and tankage.

January, 1916.

a. Have pupils tabulate the feeds fed to hogs at home.
   1. To sows in summer.
   2. To sows in winter.
   3. To sows in spring after farrowing.
   4. To pigs before weaning.
   5. To pigs after weaning until sold.

b. Have pupils find out when the fat hogs are sold, how much they weigh and their age, and when possible what it cost to produce them.

How much should a hog weigh at 8 months?

At what age will he weigh 300 pounds?

What will he gain per day from weaning time until he weighs 300 pounds?

Why are hogs more popular than sheep in your community?

February, 1916.

a. Draw a picture of sheep with wool on and with the wool sheared. Locate the parts on this picture as shown on score card.

b. Draw an outline of the sheep's carcass and locate the cuts of mutton. Put prices on the different cuts and learn uses of same.

c. About as in the case of the hog, do the score card work for sheep. Where there are no sheep in the locality, make some study of the texts and bulletins but give more time to the other kinds of live stock.

March, 1916.

STUDY OF WOOL.

a. How do you tell fine wool from coarse wool? What is yolk? What is wool worth per pound? If there are any sheep in the neighborhood get a sample of the wool and study it for length of fiber, diameter of fiber, crimp, softness, luster, yolk, strength, condition, etc.

b. Study uses of wool.

Trace the wool from the sheep's back through the wool warehouse, mills, clothing stores to the boy's back.

c. Advantages of sheep on the farm. Some of these are:
   1. Eat weeds.
   2. Maintain fertility of the soil.
   3. Low initial cost in starting a flock.

April, 1916.

Make a preliminary study of horses, preparing for the scoring and judging that will following next year.

a. Draw the outline of the horse and locate the parts. Compare with score card and study score card.

b. Study the different types or kinds of horses. Learn something about the different breeds of horses. Do as much of this as possible by finding what kinds are represented in the community.

DAIRYING.

Seventh and Eighth Grades, 1915-1916.

DAIRY PRODUCTS.

September, 1915.

Dairying—

A. Survey all, or a portion of the school district, noting the number of live stock farmers and grain farmers; of those that keep live stock, note those that keep dairy stock; study methods of disposing of crops. What are the products sold from the farm?

B. Make a list of all products derived from milk; note the composition of the milk and the various materials found in the by-products.

October, 1915.

Breeds of Cattle—

A. Using the material collected during September, study the different breeds of cattle found in the school district; note the breeds found upon the dairy farms; study variation in type of product sold from dairy farms having different breeds of dairy cattle. (All grade animals should be classed with the breed to which they are the most closely related.)

B. List the breeds of cattle according to their chief function; compare the type of the various breeds of cattle and note their special adaptation.

November, 1915.

Dairy Breeds—

A. Study the history of the dairy breed from the standpoint of their geographical location; note the courses followed in their development and their present numerical standing in the United States and in Indiana.

B. Through the use of the score card, study the various points of a dairy cow and memorize the names applied as given by the score card and note its application to maximum dairy performance.

C. Visit farms conveniently located to the school and select individuals in accordance with points previously discussed. Note breeding of the various individuals that constitute the dairy herd; select the best and poorest in the herd from the standpoint of conformation.

December, 1915.

Selection of the Individual Cow.

A. Select, in accordance with the instructions given, the three best cows in the home herd; keep accurate record of the milk produced morning and evening and note which is the highest producer; draw blanks on which daily records of milk produced may be kept; compare results with various herds and various individuals.

B. Review work for November.

January, 1916.

Milk and Cream.

A. Have pupils bring samples of milk in small fruit jar; keep samples in warm place and note change in physical condition, odor and taste; briefly explain the cause and change of condition; heat sample of milk and place in clean jar; note time required in souring sample and explain reason.

B. From sample of milk presented by pupils, collect samples of cream; explain what portion of the milk constitutes the major solid found in the cream; explain why the cream rises; keep one clean and one dirty sample of cream and note changes, physical conditions, odor and taste.

February, 1916.

Butter and Cheese.

A. Collect small samples of cream and place in half gallon fruit jar, permit to sour, then shake until butter collects; explain principle involved in churning of butter, composition of commercial butter, why salt is added, and at what season of the year butter color is needed.

B. Make collection of the various types of cheese and in domestic science laboratory have pupils prepare a small amount of cottage cheese; explain what portion of milk is used in the manufacture of cheese and the amount of cheese made from one hundred pounds of milk.

March, 1916.

Condensed Milk and By-Products of Milk.

A. Secure samples of condensed milk and milk powder and describe method of manufacture of each; prepare samples of milk, using these materials and give pupils an opportunity to become acquainted with the peculiar characteristic of each; consider the economical importance of these two materials.

B. Make a collection of all materials derived from milk not included in the above sketches, such as buttermilk, whey, and milk sugar. Explain carefully the solids found in these by-products and discuss the economical importance.

April, 1916.

A. Review.

POULTRY.

September, 1915.

Poultry Conditions in the District, Township or County.

1. Material and Equipment—
   None is needed.
2. Demonstration Exercise—
   1. Each pupil should take a certain area in his immediate home community and count all the chickens, listing the different kinds and making an estimate of their value.
   2. With several such sets of figures it would be possible to work out the value of poultry in the county. This

might then be compared with other counties and finally with other states, thus finding the value of poultry on the farm.

3. Home Project—

Find out the amount and value of eggs and poultry consumed at home during the past year and compare it with some other live stock such as the hogs or the cows. This will bring out the wonderful productive power of the little hen.

October, 1915.

Marketing Poultry.

1. Material and Equipment—

Birds from the home flocks.

2. Demonstration Exercise—

Each pupil must dress and draw a fowl at home and bring it to school to be judged as a market fowl and for correctness of dressing. The pupils should be allowed the privilege of preparing the birds in any way they see fit. The teacher should show them the difference between a scalded and dry picked bird and point out the advantages of the latter method. Better methods of dressing, which include the removal of the tendons and possibly the wishbone should be made interesting and practical. The value of appearance of both the product and the package must be shown in order to make the incentive for improvement.

It would be advisable to bring out the different market grades of poultry, the time they are demanded on the markets and the different values of each. The results of this should show the value of marketing chickens early.

3. Home Project—

Have each pupil show the parents at home how to remove the tendons from a fowl's leg, and thus make an old bird more tender.

November, 1915.

Sanitation.

1. Material and Equipment—

   Spray pump. Spray materials, some of which can be already mixed and some of which can be mixed by the pupils. A hen house that needs cleaning. Broom, bucket, scrub brush, cloths and other cleaning material.

2. Demonstration Exercise—

   The group of pupils should if possible make a spray mixture such as kerosene emulsion or else use the already prepared spray mixtures and simply dilute them.

   A poultry house and yard should be chosen and the sanitary feature of it improved by the following methods.

   1. Spade up the yard and plant seed.
   2. Spray out and clean thoroughly the hen house.
   3. Wash the hen house windows.
   4. Take out all loose fixtures and sun them after cleaning.
   5. Spray the house thoroughly with a strong solution. Soak all parts of the inside and waste rather than save the spray.

   4. Bring out the valuable features of sanitation, laying emphasis on "prevention" rather than "cure". Three general means of aiding sanitation are planting crops, sunlight and spraying.

3. Home Project—

   Have each pupil bring a written description of the sanitary features of the poultry house and yard at home. He should then improve conditions as suggested by the teacher. After which an essay is written on conditions as then found.

December, 1915.

Poultry Feeds.

1. Material and Equipment—

   Several bottles or pasteboard boxes. Samples of all common grains, mill by-products, animal by-products, grits, etc.

2. Demonstration Exercise—

   The work should be divided into three groups. (1) Grains. (2) Grain by-products. (3) Animal by-products and mineral matter. Each student should first

bring in from home, if possible, samples of all the different kinds of grains. The names, value and uses for poultry should then be learned. This should be followed by collections of materials for groups (2) and (3). This will teach the pupil that corn alone is not a good feed for poultry and that there are many feeds available that have efficient and economic uses.

January, 1916.

Judging Poultry.

1. Material and Equipment—
   A few birds of several varieties. It is suggested that the black, buff or white varieties of the common breeds such as Plymouth Rocks, and Wyandottes be used.
2. Demonstration Exercise—
   About four white birds of the same breed should be cooped at a convenient place and comparison judging used to determine the best of the group. Without having had the class, breed, and variety characteristics, only the general characteristics can be given consideration in placing the birds. The plan should be to learn how to pick out the best bird for breeding, rather than for show.
3. Home Project—
   Every pupil should choose from among the home flock the best male or female birds and mark them for breeding purposes. These breeders should then be separated and their eggs set in preference to others during the hatching season.

February, 1916.

Feeding Laying Hens.

1. Material and Equipment—
   If conditions were ideal a flock of poultry could be kept on the schoolhouse yard or very near by. If this is not possible no equipment is needed except that used in December.
2. Demonstration Exercise—
   There are two ways to do this. One is to use two flocks in order to allow for comparison, and the other is to simply keep one flock. With the latter have each pupil,

where possible, get part of the home flock turned over to him for his attention. A good ration is—10 lbs. to 15 lbs. corn; 10 lbs. to 5 lbs. wheat; 5 lbs. oats; 5 lbs. bran; 5 lbs. shorts, and 3½ lbs. meat scrap or 50 lbs. skim-milk. Careful and thorough instruction on the necessity of feeding meat scrap or skim-milk must be given. On this hinges the success of the work. When each pupil gets a flock picked out it should be fed according to directions for two weeks or a month, and a record kept of all feed expenses and income. Much can be made out of this, besides information along poultry lines.

March, 1916.

Natural Incubation and Brooding.

1. Material and Equipment—
   One brood coop, 2 broody hens, 2 settings of eggs. Feed for chicks—Charts on embryology.
2. Demonstration Exercise—
   Set 2 hens on 13–15 eggs each, and have pupils care for them. If broody hens are hard to obtain bring out the value of early hatching to insure winter layers and hence early setters. When the chicks hatch, give them to one hen and have pupils care for the brood. It is advisable to keep these on the school grounds where details of natural incubation and brooding can be discussed. If possible, charts showing the growth of the embryo will be of interest. The use of the tester on 7th and 14th day should be shown.
3. Home Project—
   Each pupil should set one or two hens at home and care for the chicks when hatched.

April, 1916.

Egg Grading and Testing.

1. Material and Equipment—
   A few home-made egg testers, several dozen eggs, and a few eggs with different qualities both inside and out.
2. Demonstration Exercise—
   Each pupil should take several dozen eggs and pick out the three best dozen, considering weight and outside

conditions. Following this, each pupil might place in 1—2—3 order the 3 dozen picked out by some one else. With the egg tester eggs of different qualities such as fresh, stale, spot, rot, etc., should be learned.

3. Home Project—

Each pupil should candle or test a certain number of eggs at home and pack them for market, sending only the good ones away. Small, cracked, dirty, stale, and rotten ones should never be sold.

4. Points of Information—

Candling:

A. When the candler tests the eggs he bases his judgment on the following indications:

1. *Fresh*—Opaque, the contents should only show up slightly, usually the yolk is only dimly visible. White shelled eggs are much more opaque than brown shelled ones. The air cell is about the size of a dime in a strictly fresh egg. As the egg gets old the water evaporates through the shell and the air cell becomes larger.
2. *Stale or Held*—The air cell is larger than in a fresh egg. The yolk may be more visible.
3. *Heated*—The air cell may be small or large, but the egg has a rather muddy or watery appearance. Heated eggs are due to storing in too warm a place or keeping in hot sun.
4. *Developed Germ*—Dark spot visible, from which radiates plainly visible blood vessels. The young germ is sometimes referred to as looking like a spider web.
5. *Dead Germ*—When a germ dies the blood forms in a ring around the germ. This ring may be plainly visible around the dead germ or the germ only may show up. But the radiating blood vessels are always absent. Sometimes the germ sticks to the shell.
6. *Rotten*—Muddy or very dark in appearance, yolk and white mixed. Air cell large and sometimes movable.
7. *Mouldy Eggs*—Show a distinct irregular black spot on the inside of the shell. They may be very small or cover the entire shell. Moulds often get in

through cracks and are thus often found in a cracked egg.

8. *Blood Clot*—Is a clot of blood on the surface of the yolk. It is present when the egg is laid. Very plainly visible bright red. They vary in size, many are one-fourth inch in diameter.

Grading Eggs:

A. In grading eggs and considering weight and outside conditions only, weight is the most important factor and all eggs should weigh 24 ounces or more per dozen. Eggs to grade best must be uniform in size, shape and color and absolutely clean. Next to weight, uniformity is of most importance. In grading eggs commercially eggs are tested or candled, and all undesirable eggs rejected.

HORTICULTURE.

Seventh and Eighth Grades, 1915-1916.

IMPORTANT.

In order that the work in ornamental gardening may be done on a practical basis it will be necessary for the pupils to collect materials in September and October to be used during the winter and spring months. These materials will consist of adult insects, eggs, larvæ, pupæ, twigs infested with blight, mildews, rust, San Jose, scurvy bark, oyster shell, rose, and cottony maple scales, fall web-worm, canker worm, various borers, aphids, leaf beetles, etc. This material should be properly mounted in order to preserve it in good condition. For specific information on collecting and mounting such material secure from the U. S. Department of Agriculture, Washington, D. C., Farmers Bulletin on Collecting and Preserving Plant or Insect Material for School Use. Secure also State Entomologist Report, 1912-1913, Indianapolis, Indiana.

September, 1915.

Identification of Shade Trees and Shrubs.

Identify the shade trees and shrubs in the neighborhood. Have pupils describe autumn foliage. Later give several kinds of trees numbers and have pupils write down what kind of tree each one is by the numbers.

If possible, locate and have pupils become familiar with the following native plants. Try to teach the beauty of these native plants and instil a love of the *natural* style of landscape gardening rather than the artificial or attempted formal style:

Native Shrubs—Elder, Wild rose, Sumac, Nannyberry, Hazel, Silky dogwood, High bush cranberry, Maple leaved arrow-wood, Downy leaved arrow-wood.

Native Vines—Bittersweet, Trumpet creeper, Wild grape, Wild clematis, Wild woodbine, Virginia creeper, Trumpet honeysuckle.

Native Small Trees—Flowering dogwood, American hawthorne.

October, 1915.

Bulb Planting.

Encourage the planting of bulbs for the home flower garden, and if possible plant some in naturalized borders on the school grounds.

Make a list of flower bulbs planted in the fall.

The following is a list of those with which success is almost sure: Narcissi, Hyacinth, Tulips, Snow Drops and Crocus.

Explain the necessity of good seed beds for bulbs. Tell how to make a good seed bed by considering the following points: Depth, drainage, fertilization, never use fresh manure for fertilizing bulbs, kind of soil, etc.

Discuss the time and method of setting out fall bulbs.

Explain some of the things to consider when locating the bed for the fall planted bulbs.

Why should you consider the habits of growth in arranging the bulbs in the bed? Also consider the time of blooming.

Prepare a bed for bulbs on the school ground.

November, 1915.

Trees, Shrubs, and Flowers.

Make a field excursion and study the bare trees and shrubs. Notice their shape and characteristic growth, color of wood, and berries on shrubs.

What age of tree is best to set out? Is anything gained by setting out an extra large tree?

Emphasize value of fruit trees, shade trees and trees for lumber. Teach the conservation of the wood lot by cleaning out dead, misshapen, crowded trees and preventing fires in wood lot.

Transplant small trees to steep hillsides, stream banks, and roadsides. Will greatly improve these waste places.

Explain the classification of flowers according to the length of time they live (annuals, biannuals, and perennials).

Emphasize *perennial flowers.* Some of our most beautiful flowers belong to this class. Discuss their place in the flower garden, method of propagation, care, location, etc.

The following list is one that can be successfully grown by the boys and girls of this grade if they will give them the necessary care: Phlox, Peony, Asters, Pinks, Chrysanthemum, Columbine, Bell Flower, Larkspur, Bleeding Heart, Fox Glove, Blanket Flower.

December, 1915.

Window Gardening.

The place of plants in the home. Question as to the healthfulness of plants in the house.

Pleasure to be derived from growing plants, especially in winter.

There is more to growing house plants than merely putting them in a can and watering them once in a while.

Emphasize the above fact by considering the soil best suited to different flowers, providing drainage, health of plants, temperature best adapted to plants, watering, providing plenty of available plant food, etc.

Discuss each of the above points rather fully and have plants in the room for demonstrating the different points.

Potting and repotting—size of pot, size of flower, when to repot, how much larger the size of the pot should be, and how to proceed with transplanting a potted flower.

Study plants adapted to different exposures. Flowering plants will not do well in a north window, while this window would be best for the shade loving foliage plants. Select plants that can withstand variations in temperature.

Reference—

H. B. Dorner, "Window Gardening."

January, 1916.

Plans for Home Grounds.

Have the pupils draw a sketch of their homes and locate on it some places suitable for flowers. Some places are suited to the

use of climbing plants, some places to tall upright plants, others to plants that can endure considerable shade, etc.

Locate on this plan some of the native shrubs and vines and flowers and trees which were studied in September.

Demonstration Exercise—

Make a landscape planting plan of the school grounds. It should be planned if possible to have:

1. A good open lawn.
2. Informal borders of shrubs in masses with naturalized flowers in border.
3. Foundation plantings of vines and shrubs around the buildings.

In this plan use the native shrubs and trees and vines which were located and studied in September. All of these would work wonders in beautifying the school grounds and at the same time they could be obtained free by digging them in the woods and transplanting.

In addition to the native shrubs and vines it would be very desirable to include some of the following ornamentals if possible.

Inexpensive Annual Vines—Morning glory, Wild cucumber.

The following plants would be very desirable if they could be purchased: Peonies, Dahlias, Lilacs, Hydrangeas, Iris, Crocus, Daffodils.

February, 1916.

Study of Pests of Ornamental Plants—Study Pruning of Shrubs, Trees, and Plants—

Classify pests as to the manner in which they attack plants,—sucking and biting insects, fungous diseases.

In this study make use of materials collected and mounted during the fall months.

Study of spray materials to be used in controlling the different classes of pests. Arsenate of lead, Bordeaux, lime and sulphur, nicotine sulfate, etc., are among the sprays that should be studied. As far as practicable samples of these sprays should be manufactured in the laboratory.

The actual work of pruning and spraying should be carried on during the spring and summer.

March, 1916.

Spring Planted Bulbs.

Bulbs planted in the spring produce some of our most showy flowers and should be given due attention.

Among the most common are the Cannas, Dahlias (really not a bulb but usually classed as one), Gladiolus, Mont Bretia, Tuberose, Oxalis, and others.

Study the habit of growth, season of blooming, seedbed preparation, and culture of some of the above, especially the cannas, gladiolus, dahlia, and caladium.

Have pupils go to woods and dig up some of native shrubs and vines and transplant to school grounds according to plan made in January.

Study the spring wild flowers and teach the pupils the beauty of these flowers.

April, 1916.

Tree Planting.

Continue study of spring wild flowers as season advances, transplanting some in informal borders in school yard.

Prepare a bed for spring planted bulbs and set out a nice bed.

Plant an informal border of the school ground to the more hardy perennials.

Discuss the care of the lawn. Emphasize watering and mowing, also the fertilizing of the lawn so as to get a good thrifty stand.

Observe Arbor Day and plant ornamental or fruit trees on school grounds and encourage tree planting at home. Fruit trees planted now will yield bushels of fruit when the children are grown up.

The following outline may be followed in planting fruit trees:

Outline of Study—

Combine this exercise with the Arbor Day program. Plant an apple or cherry tree on the school grounds for the pupils to observe. Trees for this purpose will generally be donated by some public-spirited citizen or by the larger nurseries of the country. Why should top of tree be reduced? Why not put fertilizer in hole with tree? What kind of a tree should be planted? What economic use will it have? The following will be needed: Two or three nursery trees—fruit trees preferred. Spade. Tree wrap.

Demonstration Exercises—

Prune top of tree to correspond with root area. In digging, tree has lost about three-quarters of its roots. Top must be reduced to restore the equilibrium. Remove interfering branches, branches which make bad crotches, diseased branches and weak branches. Select three or four sturdy branches for the scaffold limbs and shorten them to about half their length. These are the only branches left. Cut roots to healthy wood. Make cuts slanting so that soil will pack well around the wounded ends. Dig hole deep enough and large enough to accommodate the roots. See that soil is in contact with every root and that it is compacted as the hole is filled. Leave the last few shovelfuls loose to serve as a dust mulch around the tree. Do not water tree except in extreememely dry weather, then pour water in hole when soil is about half in. Do not put fertilizer in hole with tree. Use a mulch after the tree is planted. Early the next winter wrap body of tree with screen wire or tar paper to protect it from rodents, removing same in spring.

SOILS.

Seventh and Eighth Grades, 1916-1917.

September, 1916.

Temperature of Soils.

I. Material and Equipment.

One or more thermometers. Price of each about $1.00.
Clay, loam, sandy soils; one gallon of each.
Boxes, 10 inches long, 8 inches deep, 6 inches wide.
Lime, 1 pint; lamp black, 1 box; tip cups.
One-gallon buckets (one or two with small holes in bottom).

II. Method of Procedure.

a. Demonstration Exercises—

1. Temperature of clay, loam and sandy soils in boxes, buckets or cans.
2. Clay soil covered with lime.
3. Clay soil covered with lamp black.
4. Loam soil covered with lime.
5. Sandy soil covered with lamp black.
6. Loam saturated with water and not drained.
7. Loam saturated with water and then drained. (Use box or can with perforated bottom.)
8. Soil with slanting exposure to the sun.
9. Soil with vertical exposure to the sun.
10. Soil with compact surface (both field and laboratory).
11. Soil with loose surface (both field and laboratory).
12. Clay soil with which sand (half and half) has been mixed.
13. Clay soil with which decayed vegetable matter has been mixed.
14. Sandy soil with which loam has been mixed (half and half).

For each of the above exercises place the soil in the containers provided (boxes or buckets). Place in the sun and leave from two

to four hours. Insert the thermometer about four inches. Within 15 or 20 minutes, or as soon as the liquid in the thermometer has risen as high as it will, record the reading.

b. Home Projects—

The soils used in the laboratory should be collected by the pupils from plots on the home farms. The plots from which soils are taken should be those that are to be used by the pupils for growing vegetables or some farm crops, such as corn or alfalfa.

At the time when the demonstration exercises are being carried out at school, the pupils and their parents should be taking temperature measurements of the soils on the plots from which the samples were collected. Readings should be taken once or twice per month during the fall and spring, and during the winter, when possible. Measuring soil temperatures should not be limited to the selected plots but should be extended so as to include all conditions affecting temperature of soils. Complete records of the thermometer readings should be kept by the pupils. This home work is important and should not be neglected.

Parents and children should be encouraged to attend the monthly township institute and discuss with the teachers the results of the month's work in agriculture and make plans for the next month's work. Community betterment clubs could be organized and in the regular monthly meetings the parents, pupils and teachers can discuss together the agricultural work.

III. Points of Information.

The germination of seeds is dependent on three conditions: moisture, heat, and air. The temperature of the soil very greatly influences the germination of seeds as well as the growth of the plants. Some seeds germinate best at a rather high temperature while others germinate best at a lower temperature. The seeds of plants which were tropical in their origin require high temperatures, corn for example. Crops which originated in temperate regions, like wheat and oats, germinate at lower temperatures. As a general statement, we may say that a temperature of 85 degrees Fahr. is most favorable for the germination of common seeds. As a matter of fact, however, the temperature in the soil of a field is

rarely so high as 85 degrees at planting time. This partly accounts for the fact that the stand of plants is not in proportion to the amount of seed sown, seeds of low vitality not germinating. It can be demonstrated in the laboratory that wheat and oats will germinate at temperatures of 60 degrees Fahr. quite readily, while corn will scarcely germinate at that temperature and melons not at all. Clover seed will germinate at still lower temperatures. Some of the weed seeds will germinate at a temperature close to freezing.

Several things affect the temperature of the soil:

1. Moisture. When soil is water soaked it will have a low temperature, due to evaporation of the water from the surface of the soil. Also the presence of water keeps the warm air from entering the pores of the soil and warming it.

2. Color. Dark colored soils are warmer than light colored soils, due to the fact that black absorbs heat.

3. Texture. Coarse, sandy soils are warmer than fine clay or loam soils, due to the fact that they are well drained and have large pore spaces for the circulation of the warm air.

4. Slope. Land which slopes to the south is warmer than that which slopes in another direction, due to the fact that it receives the rays of the sun more directly.

5. Compactness. A compact soil will become warmer in the summer months than a less well pulverized soil. This is because a compact soil will conduct heat better and also because it dries out more thoroughly than the well pulverized loose soil.

Land well underdrained and well supplied with organic matter will have a more uniform temperature during the growing season than soils not in such condition because the moisture content will be larger and more uniform. The presence of moisture in the soil has a tendency to keep it cool.

October, 1916.

Moisture in Field Soils.

I. Material and Equipment.

Six tomato cans with string bails.
One spring scales with gram and ounce graduations.
Composite samples of soils to depth of six inches.
Two quart samples each of the clay, loam and sand.
Two half-gallon buckets or glass jars.
Plants with heavy foliage (whole plant) (corn, flower or weed).

II. Method of Procedure.

a. Demonstration Exercises—

1. Weigh composite sample of each of the three soils.
2. Weigh samples of each after having been thoroughly dried. (If samples are dry when procured, moisten for the first experiment.)
3. Set plants in buckets or jars three-fourths full of water. From one plant strip the foliage. Cover the containers with heavy paper to prevent evaporation. Which plant uses the greater amount of water? How is the water taken up?
4. Plant beans, radishes or turnips in loam soils. Use boxes at least ten inches deep. Bore holes in bottom of boxes. Set on small sticks so that air can circulate through the soil. Keep the soil in one box thoroughly saturated with water. Keep soil in the other box normally moist. Note in which soil the plants grow better.
5. Twice each week for three weeks stir, to the depth of three inches, wet clay soil, in a box about 2 feet long, 1½ feet wide and 1 foot deep.

Through the school and home work, information should be obtained on (a) amount of water used by plants, (b) why water is necessary, (c) how plants feed, (d) why plants sometimes wilt when there is some moisture in the soil, (e) why plants die when there is an excess of moisture, (f) kind of water which plants use, (g) effect on tilth of soil of too great or too small an amount of water, (h) best soil for proper moisture content under natural conditions.

b. Home Projects—

Soil samples should be taken from the plots referred to under the topic for September. The parents should cooperate in the manner suggested in the discussion of "Temperature of Soils." Pupils should report in writing the results of their observations of germination of seeds and growth of plants in soils of different kinds and of different degrees of moisture content.

The home work is more important than the school laboratory exercises and should not be neglected under any circumstances. The fact that the pupils are to use the home

plots for practical work during the summer should be given proper emphasis at all times.

III. Points of Information.

In order that a plant may grow well, it needs to have a sufficient supply of moisture. The water makes the cells of the plant turgid. This turgidity keeps the plant erect and thrifty. When plants begin to wilt it is due to the lack of sufficient water in the cells to keep them turgid or completely full. The plant obtains this moisture from the water in the soil. In the soil the water is contained on the surface of the soil particles and in the very small pore spaces between them. The very fine roots of the plant come in contact with this moisture and absorb it and pass it upward to the leaves of the plant. This moisture not only keeps the cells turgid but it also carries the plant food in solution. This plant food is nitrogen, phosphorous, potash, iron, etc. In the leaves these various elements are combined with the carbon which the leaves have taken from the atmosphere, and the various tissues which go to make up the plants are thus formed.

It has been noticed that some plants withstand dry weather better than others. This is due to the fact that they can obtain moisture from the soil where other plants cannot. Also to the fact that they do not use as much moisture as others. Plants which have deep roots, like alfalfa, scarcely ever suffer from dry weather while plants with their roots near the surface, like grass, dry up in a dry period.

It is also true that it is easier for plants to get the moisture which is contained in sandy soils than to get the moisture contained in clay or loam soils. A clay or loam soil may have ten or twelve per cent. moisture in it when the plant is wilting, while in a sandy soil when the plant begins to wilt, the moisture may be as low as three or four per cent.

November, 1916.

Capillary Water in Soils.

I. Material and Equipment.

Clay, sandy, and loam soils, muck (1 qt. of each). Four lamp chimneys (or $1\frac{1}{2}''$ to $2''$ glass tubes from 2 feet to 5 feet in length).

Muslin and twine string.

Shallow pans.

Racks for chimneys or glass tubes.

II. Method of Procedure.

a. Demonstration Exercises—

1. Fill one chimney or tube with clay soil, one with loam, one with sand and one with muck. Muslin must be tied over the bottoms of the containers to prevent the dirt from falling through. Set the chimneys or tubes in pans containing an inch of water, or suspend them in racks and set under them cups or pans containing water. In which soil does the water rise most rapidly? Why? If long tubes are used, in which soil does the water rise highest? Why? What is capillary water? What is free water? What is hydroscopic water? Form of water used by plants. Why free water is harmful. Relation of this exercise to practical farm problems.

2. Thoroughly mix a pint of loam with a pint of sand, a pint of clay with a pint of loam, three-fourths of a quart of clay with one-fourth of a quart of vegetable matter fully decomposed and finely pulverized, one pint of sand with one pint of pulverized, decomposed vegetable matter. Continue as under exercise No. 1. Can clay and sandy soil be improved for upward movement of water?

3. Fill a chimney or a tube half full of loam, then put in an inch of wheat, oats or clover chaff, and then fill with loam. In another sample use small clods instead of chaff. Continue as under exercise No. 1. What effect does the seed bed have on the capillary movement of water?

b. Home Projects—

Have the pupils study the conditions of the soil in the fields and the home gardens in which the corn and vegetables are to be grown next summer. In the light of information gained from the laboratory experiments, have the pupils determine whether or not the soils in the fields and gardens are in condition to facilitate both the downward and upward movement of water through them, and whether or not the soils can be improved in these particulars. How can they be improved?

III. Points of Information.

Water exists in the soil in three conditions:

1. Free, or hydrostatic.
2. Capillary.
3. Invisible, or hygroscopic.

Capillary water is so called because it exists in the very small (capillary) pore spaces of the soil. It not only fills the small pore spaces but it also covers the surface of the small particles with a thin film of moisture. While the capillary water is thus contained in the soil, free water is that which may exist in the large pore spaces of the soil and is free to drain away if there is opportunity for it to escape, as for example, through tile drains or a gravelly subsoil. Free water does not remain if there is opportunity for it to escape. Capillary water remains until it is used up by plants or carried away by evaporation.

Capillary water moves in the soil by creeping over the surface of the particles. The movement is toward the place of less moisture. Everyone has observed how the oil moves upward in the lamp wick or how the chunk of loaf sugar sucks up water. Both these cases are instances of capillary movement. The action in the soil is similar.

The capillary water in the soil is the only one of the three forms that is useful to plants. It is the moisture which the plant roots absorb and it contains the plant food in solution which the plant uses for building up its tissues. Ordinary soils will hold capillary water to the extent of about 35% of their volume. This percentage of capillary water is more than is good for the growing of plants and seeds. About 15 to 20% of the capillary moisture is best for the growing of plants. Free water in the soil is likely to be harmful because it closes up the large pores of the soil and prevents its aeration and if it has to escape by evaporation it keeps the temperature of the soil reduced.

December, 1916.

Soil Acidity.

I. Material and Equipment.

Clay, sandy, and loam soils, muck ($\frac{1}{2}$ pt. of each), four glass tumblers, blotting paper, red and blue litmus paper, fresh rain water, $\frac{1}{4}$ pt. of lime.

II. Method of Procedure.

a. Demonstration Exercises—

Take a glass tumbler and fit a circular piece of clean blotting paper in the bottom, lay under this strips of blue and red litmus paper, add a handful of soil from the home field, saturate with fresh rain water. After half an hour note the effect upon the litmus paper by removing the soil and the blotter.

Test samples of the four types of soil in this way.

To another sample of soil prepared in the tumbler for the litmus test in this way, add a sprinkling of lime. What effect does this have on the red litmus paper? Did any of the samples turn the blue litmus red? What does this indicate? How would you correct this condition?

Soil may be tested for acid by thoroughly moistening it and placing it in a piece of blue litmus paper.

Try to grow radishes, clover or beans in boxes containing acid soil.

b. Home Projects—

The samples of soils to be used in the above exercises should be collected from the home fields and gardens. These samples should be taken from about two to four inches below the surface. Each should be carefully labeled as to field or garden and exact location from which taken. The samples should be secured before the ground freezes.

The fields or gardens that have acid soils should be visited by the class. Every member of the class should make a list of the plants found growing there. (In most cases, perhaps, this can not be done in December, but the visit can be made in the spring.) They should examine the texture of the soil, classify the soil, note drainage conditions, study ventilation of soil, and observe whether shaded or not. Could the conditions be improved? How?

III. Points of Information.

Soils are said to be sour, neutral, or alkaline. The neutral or slightly alkaline condition is the desirable one for practically all farm crops. Nearly all of the plants that we call legumes will not thrive on soils that are called sour, especially clovers and alfalfa.

It is not easy to explain just how a soil is made sour, but some of the conditions which produce sourness are, lack of drainage, close, compact nature of the soil, continuous cropping, and absence of lime. Many of the muck or peat beds are sour, due to the constant decay of vegetable matter, absence of lime, and lack of aeration.

Whether the soil is sour or not can be determined fairly accurately by the use of the litmus test. Litmus paper can be obtained from the druggist. When blue litmus paper turns to a pinkish color after being in contact with damp soil for a short time, it is a pretty sure indication that the land is acid. To grow clovers and alfalfa successfully, it is desirable that the acidity be removed. This can be done by an application of lime to the land. Crushed or ground limestone is most commonly used for this purpose and under ordinary conditions, an application of 2,000 to 3,000 lbs. per acre is sufficient to correct acidity. It is best to apply this lime to the surface after the land has been plowed and work it in with harrowing and disking.

January, 1917.

Fertility of Soils and Subsoils.

I. Material and Equipment.

1 quart of clay soil and 1 quart of subsoil.
1 quart of loam soil and 1 quart of subsoil.
1 quart of sandy soil and 1 quart of subsoil.
6 tomato cans.

II. Method of Procedure.

a. Demonstration Exercises—

Plant beans in 1 qt. of clay and 1 qt. of subsoil.
Plant beans in 1 qt. of loam and 1 qt. of subsoil.
Plant beans in 1 qt. of sand and 1 qt. of subsoil.
Allow plants to grow. Which produce the largest plant?
Why is this soil darker than the sub-soil?
Which is more fertile and why?
Should large quantities of subsoil be turned up by the plow at any one time? Why is this so?
What is the effect of the character of subsoil on drainage?

b. Home Projects—

Secure the samples from the home fields and gardens. Study the characteristies of soil and sub-soil to a depth of two or three feet in the places from which samples are taken. This field work will have to be done in the fall or spring. Pupils should make inquiry of parents and neighbors as to their experience in plowing up two or three inches of subsoil at one time.

III. Points of Information.

Everyone has observed that where the soil has been thrown out from a deep ditch or exeavation, that very few plants grow on it for two or three years, but gradually this soil becomes covered with all the plants that naturally grow in the vicinity. The reason so few plants grew in this soil the first year was because the subsoil was too raw, or, in other words, had not become weathered. This raw soil that has been thrown out of the exeavation is subsoil. The same result would likely happen in our fields if we were to plow several inches deeper than usual and throw up on the surface three or four inches of the under soil. This under soil contains about as much plant food as the upper soil, espeeially of those elements we eall minerals. It does not contain so much nitrogen. After this subsoil has been subjected to freezing and thawing, its plant food becomes more available and will support plant life.

There is also another factor which influenees the productiveness of the subsoil that we have not spoken of heretofore. The subsoil does not contain nearly so many soil bacteria as the upper soil. The presence of these bacteria have a decided effect upon the value of the soil as a place for plants to grow. After the raw soil has been on the surface for a year or two it becomes infested with the bacteria the same as the other top soil and so becomes available for plants. The introduction of organic matter into this subsoil also makes it more useful for plant growing.

The nature of the subsoil very greatly affects drainage. Where the subsoil is hard and compact, the water moves through it very slowly and it takes some time before tile drains become effective in such soils. In sandy and gravelly subsoils the water moves through very easily and if the sand or gravel layer is very deep, the water may escape so quickly that the upper soil will be the sufferer on account of it.

February, 1917.

Effect of Mulch in Preventing Evaporation.

I. Material and Equipment.

½ gallon loam soil.
2 flower pots.
Clover or alfalfa seed.
2½-gal. buckets, or 6 tomato cans.
Clay, loam and sandy soils.
Pair of scales weighing to 1g.

II. Method of Procedure.

a. Demonstration Exercises—

1. Fill two flower pots with loam soil and plant seeds in each. Do not cover the flower pots. Keep the soil in each pot in proper moisture condition for the germination of seeds and the growth of plants. Be sure to put equal amounts of water in each pot. After the plants have obtained a growth of about two inches, cover the soil in one pot with a one-inch layer of dust. Place the pots in a window and note which plants first show the need of water.

2. Fill half-gallon buckets or tomato cans with soil, two with loam, two with clay and two with sand. Saturate with water the soil in each container. Weigh container and soil. After the top soil has become dry enough to be worked, stir to the depth of one inch. Weigh container and soil. Cover one sample of loam, one of sand, and one of clay with dust to the depth of one inch. Every twenty-four hours, for 10 to 14 days, weigh the samples covered with dust and those not covered. Record weights. Which loses the greatest amount of moisture?

b. Home Projects—

As soon as the soil is ready to be worked in the spring the pupils should try out on the farms the value of a dust mulch.

Explain the meaning of a soil mulch. What is a "dust mulch"? What is the proper depth for a soil mulch? How often should a soil mulch be renewed? Why should soil be cultivated after a rain? Methods of producing a "dust mulch." Other soil mulches.

III. Points of Information.

A soil mulch is a loose layer of soil an inch or two deep covering the surface. This layer, by reason of its looseness, prevents the movement of capillary water through it. As the capillary water cannot move through this loose layer, there can be no loss from evaporation except such as takes place from the surface of the leaves of the plants growing in the soil. Because of the effectiveness of a mulch in preventing evaporation, farmers are recommended to cultivate their crops in such a way as to produce a loose covering of a couple of inches in depth in order to conserve the moisture in the soil for the use of the plants during the warm and dry months of summer. The best depth of mulch is about two inches. A shallower depth will not hold the moisture so well and to make a deeper mulch will destroy a good many of the roots of the corn or potato plants.

When once a good mulch has been made it will last for ten days or two weeks without being renewed unless there is a shower of rain. The heavy soils need to have the mulch renewed oftener than light soils, because they will establish capillary connection with the under soil quicker. After a shower of rain it will be necessary to renew the mulch because the shower will have compacted down the mulch and established the capillary connection so that evaporation will take place without hindrance.

There is a difference between a dust mulch and a soil mulch. A dust mulch refers to a very fine condition of the soil in a mulch while a soil mulch refers to a condition composed of small clods and crumbs. The soil mulch in most cases will be more effective than a dust mulch.

It should be noted that moisture may be lost from the soil, not only by evaporation from the surface but also by evaporation from the surface of the leaves of the plants growing in the field. If one stops to consider the large amount of surface presented by all the leaves on the plants growing in the field and remembers that each of these leaves is evaporating some moisture into the air, one can understand that a very large drain is being made on the soil for moisture by the plants alone. Experiments have shown that a corn plant at tasseling time will evaporate a quart or more of water a day from its leaves, depending upon the atmospheric conditions.

March, 1917.

Working Soil When too Wet.

I. Material and Equipment.

One pt. each of clay, loam and sandy soil.
Four tin pie pans.

II. Method of Procedure.

a. Demonstration Exercises—

1. Stir enough water in a half pint of clay to make a thick paste. To another sample add just enough water to make the soil crumble nicely when handled. Dry both in the sun or by the fire. When dry which can be pulverized most easily?

2. Mix thoroughly equal amounts of clay and sand. Make a thick paste out of one sample. Wet another sample just enough to make the soil crumble nicely. Which can be pulverized most easily when dry? Compare samples made of clay and sand with samples having only clay.

3. Repeat the exercises, using clay and loam.

b. Home Projects—

Experiment with small plats in fields and gardens. Explain "puddling" of soils. Note relative damage to clay and sandy soils by plowing or cultivating when wet. What can be done to improve naturally wet soils?

III. Points of Information.

Every farmer knows that when he cultivates or plows his land too wet, he produces clods which become very hard. He knows too, that where his land has been plowed or cultivated too wet, the plants do not thrive well. This condition is due to the puddling of the soil by breaking it too wet. Puddling is a condition brought about by handling the soil when there is so much moisture that the particles, instead of sticking together in their natural crumb structure, slip over each other and produce a smeary, sticky mass. When the soil dries, these various masses remain "smeared" together and are very hard and compact. That part of the soil not exposed to the drying of the sun becomes tough and waxy and the roots are unable to penetrate it and when rains come again the

water does not soak into the mass readily. Thus it happens that plants growing in such soil are not well supplied with plant food and capillary moisture and become unthrifty. Where soils have been puddled by working too wet, there is very little to be done except to wait for the loosening effect of freezing and thawing. Frequently it takes more than one winter's freezing and thawing to render a soil in good condition again. Where there has been a road or lane through the field, the land is likely to be cloddy in that place for several years after it is plowed up.

Clay and loam soils are damaged most by plowing or cultivating too wet. Sandy soils and peaty soils are not much harmed by being plowed wet.

Soils that are naturally wet should be improved by drainage, the introduction of organic matter, and plowing only when they are in the right moisture condition.

April, 1917.

Aeration of Soils.

I. Material and Equipment.

2 tomato cans.
2 1-qt. Mason jars.
Clay and loam soil.
Radish, clover or turnip seeds.
2 deep cigar boxes.

II. Method of Procedure.

a. Demonstration Exercises—

1. Plant seeds one inch deep in puddled clay soil and in good loam soil in good condition to work. In which do seeds germinate and plants grow the better?

2. Plant seed in loam soil in Mason jars. Keep one jar tightly sealed, and leave the other uncovered. Note results in germination of seeds and growth of plants.

3. Fill with clay soil to within an inch of the top a tomato can with small holes in the bottom. Fill another with loam. Weight separately. Saturate each sample with water. As soon as water ceases dripping from the bottom of cans, weigh again. Which retained the greater amount of water? Which will contain most air?

4. Plant seeds in loam soil in a tomato can with perforated bottom. Plant seeds in loam soil in a tomato can without perforations. When adding water from time to time put equal amounts in each can. What are the results in germination of seeds and growth of plants?

Why do plant roots need air? What effect on soil bacteria has the presence or absence of air in the soil? Amount of air space in soils? Effect of the excess of water on the admission of air to the soil. How to secure proper aeration.

III. Points of Information.

Air is as essential for plants as it is for animals. The oxygen of the air is the element needed. Unless there is oxygen in the soil, seeds will not germinate nor will plants grow after the seeds have germinated. It is as necessary that air should circulate through the soil to keep it pure as it is that air should circulate through our rooms. The winds blowing across a field have the effect of sucking the old air out of the soil and permitting new air to enter. Tile drains in the soil also greatly assist in the aeration of it.

The presence of air in the soil is also essential to the development of the soil bacteria. Some bacteria live in the absence of air and maintain themselves with oygen by destroying various compounds in the soil which contain oxygen, but the beneficial soil bacteria need fresh air.

The amount of air in the soil will depend upon the amount of pore space as has been stated in previous lessons. Some of the pore space is filled with capillary moisture and if free water is present, the larger pore spaces are also filled. The more space filled by water the less room there will be for air. Under good condition in the soil the air spaces may amount to 15 or 20% of the volume of the soil.

Soils which are heavy and compact need to be so handled that their aeration will be improved. This improvement can be brought about by drainage, by careful plowing and by the introduction of organic matter in the form of stable manure or green manure, also the flocculation of the soil by liming will improve its aeration.

CROPS.

Seventh and Eighth Grades.

September, 1916.

Wheat Seeding:

I. Material and Equipment.

Map of U. S.
Some wheat stubble with larvæ of Hessian fly.
A sample of wheat.
Two boxes, 16″ x 20″ and 6″ deep.
Enough soil to fill the boxes.
Samples of fertilizers.

II. Method of Procedure.

Demonstration Exercises—

1. Study the climate conditions for growing wheat and the time when the fly works on the wheat.

2. Study the difference between pastry flour made from Indiana wheat and the best bread flour made from selected spring wheat.

3. Fill one box with well pulverized loam soil prepared as a model seed bed for wheat and the other box with cloddy soil not well worked. Two small plats on the school grounds or on a farm nearby would be better for the purpose and should be sown in wheat at proper time.

4. Look for Hessian fly pupæ in old wheat stubble. Examine fertilizer by smell, teste and touch. (Note the tag attached.) Study grain drill as to method of adjusting to sow different quantities of seed and fertilizer.

5. Note and record the date that first field of wheat in the community was sown; also the last field.

6. How many farmers in the community used fertilizers on their wheat ground? What brands of fertilizers were used? How much was applied per acre?

7. Examine fertilizers by smell, taste and touch. Secure tags from sacks containing fertilizer. Of what value are these tags to buyers of fertilizers?

8. Visit a farm and study grain drill as to method of adjustment to sow different quantities of seed and fertilizers.

III. Points of Information.

Time to Sow—Danger of Hessian fly—Rate of seeding—Use of fertilizer.

A. Indiana is in the semi-hard winter wheat region of the United States. Our wheat is sown in the fall, while in Minnesota they sow wheat in the spring. Give some reasons why this is so. Pupils should talk to their parents, to millers and grocers concerning the reasons why wheat needs rather cool weather for best quality, and why our summers are not adapted to wheat growing. What dangers do our farmers in Indiana meet from winter killing? Bring out clearly the differences in color and hardness between our wheat and the spring wheat of the northwest.

Some of the factors entering into the question of when to sow wheat are: (1) The need of the plant to get well started before winter sets in. (2) The kind of soil and plant food present. (3) The character of the seed bed. (4) The lateness of the season. (5) The Hessian fly. Purdue Circular No. 23 gives information relative to the time recommended for the different sections of Indiana.

Since there are several factors to be considered, is it possible to have an exact date that is always best for sowing wheat? It will be difficult to find wheat stubble in the fields after school begins and the fly ravages can hardly be detected at that time. It will be wise to collect some stubble and watch the development of the fly before school begins. The life history of the fly can be left for the November study.

Six pecks of wheat are generally sown on an acre. How does this compare with corn or oats? What effect does the stooling of wheat have upon the quantity sown? How does the number of stalks or plants to the square yard compare with the number of stalks of corn?

Learn what compounds of fertilizer are recommended for wheat. Write to a fertilizer company for samples of acid phosphate, dried blood, bone meal, muriate of potash, rock phosphate and other fertilizing materials, if these can not be obtained from some local agent. Have pupils examine these carefully. Purdue Circular No. 23 will be helpful in working out the proper formula or proportions to be used. If possible have some pupils fertilize plats at home with different fertilizing compounds.

B. The time for sowing wheat in Indiana varies considerably according to the part of the State. In the northern part of the

State wheat is sown about three weeks earlier than in the southern part. The time of sowing is regulated somewhat by the time of appearance of the Hessian fly. The Hessian fly lays its eggs early in September on the young wheat plants. If there are no young wheat plants, the eggs will be deposited on grass or weeds where the young insects will about all perish. A study of the habits of the Hessian fly indicate that it is safe to sow wheat in the northern counties of the State after September 15th; in the central part of the State after September 25th; and in the southern counties about October 1st.

The best rate of seeding seems to be about six pecks to the acre. Many farmers sow only five pecks and a few sow only four pecks. If the growing season is cool and moist, the wheat plants will stool out (produce extra shoots). In such case, one bushel of seed is likely to produce just as good a crop as six pecks, but it is safer to use the larger quantity of seed.

Many farmers now use commercial fertilizer at the time of sowing their wheat. Experience shows that the use of about 200 lbs. to the acre of a fertilizer containing from $\frac{1}{2}$% to 2% of nitrogen, 8 to 10% prosphoric acid and 2% of potash is about right. A light top dressing of stable manure after the land is plowed is also a good fertilizer for wheat.

October, 1916.

Nodules of Legumes.

I. Material and Equipment.

Several clover roots showing nodules, some roots of alfalfa, soy beans, cow peas or sweet clover that may be in the neighborhood.

A lens of pocket size or a tripod lens.

II. Method of Procedure.

Demonstration Exercises—

1. Dig up as many kinds of legumes as can be found and examine roots for nodules, e. g., the clovers, cowpeas, soy beans, vetch, etc. Make sketches showing attachment of nodules to roots and their comparative size. Use care not to strip off nodules.

2. Make drawings of the nodules found on the roots of the legumes. Show the attachments of the nodules to the roots and the length and size of the roots.

3. Some soil from a field containing nitrogen-gathering bacteria may be collected and the method of inoculation shown.

III. Points of Information.

Appearance and contents of the nodules—Functions of nodules—Inoculation.

A. Farmers have always known clover as a crop for improving the soil, but not until recently have they known a great deal about why it is good for this purpose. Note the expense of adding nitrogen to the soil in the form of commercial fertilizer. The air is the source of all nitrogen. Some weeds and some crops have the power to draw this important element from the air and leave it in the soil. What are legumes? Learn the names of as many leguminous plants as possible.

By the use of a variety of plants and good drawings get the appearance of the nodules and their purpose as clear as possible.

People generally talk a great deal about bacteria and the children have little idea of what they are. Many are useful as nitrogen-gatherers, while others are harmful. Some bacteria work in the soil without the nodules to work on, but we usually must have the legume crops to keep up the soil fertility. Should our clover fail, what can be done?

B. Such plants as clovers, cowpeas, soy beans, hairy vetch, and in fact all of the legumes, have enlargements on their roots, called nodules or tubercles. These nodules have various shapes and appearances. On the cowpea and soy bean they are nearly spherical. On the alfalfa and hairy vetch they are very much branched. On the clovers they are cylindrical in shape. In size they are as variable as in shape, those on the clovers being quite small while those on the cowpea are relatively large. The color of the nodules is usually white or flesh colored.

An examination of these nodules under a compound microscope shows the presence of a large number of small bodies, called bacteria. These bacteria are beneficial to the plants. They gather nitrogen from the air that circulates through the soil and fix it in their tissues. When the plants begin to blossom these bacteria begin to die off and give their nitrogen content to the plant. The plant changes this nitrogen to the organic compound called protein, which is a valuable feeding element. Plants that have nodules on their roots are richer in protein than plants which do not have them.

On land where a particular legume has never grown before, the bacteria which will make the nodules on its roots are usually not present and they must be introduced into the soil in order to have nodules produced. This is called inoculation. This inoculation is accomplished by taking soil from a field in which the particular legume has grown successfully and had nodules on its roots and scattering the soil over the field to be planted. The soil should be covered at once by harrowing. Various commercial firms manufacture artificial cultures of bacteria for the inoculation of the different species of legumes. Directions for using these cultures always accompany the package.

November, 1916.

Wheat Stooling and the Hessian Fly.

I. Material and Equipment.

1. A few wheat plants gathered from the field at this time.
2. A few specimens of the fly in the flaxseed stage.

II. Method of Procedure.

Demonstration Exercise—

1. Visit the wheat field and examine the wheat stems for stooling and evidences of the fly. Count the number of stems from one root.
2. Show pictures of the fly in different stages. (See Purdue Bulletin No. 30).
3. Show "Fly free date" for your part of the state.
4. Make examination and drawings of the "flaxseed" fly and of plants affected by the fly.
5. Secure the name of the varieties of wheat sown by the farmers so as to determine whether the variety has anything to do with amount of stooling.

III. Points of Information.

Weather conditions favorable to stooling—Advantage from stooling—Evidence of the presence of the Hessian fly—Pupa stage—Life history of the insect.

A. The stooling characteristic is common to many plants, particularly the grasses. When the weather is cool and moist we find the wheat and rye sending out many shoots. Wheat usually

does more stooling than oats, and it is due to this mainly that we need to sow more seed of the oats. Have the pupils go to the field for observations and comparisons.

While the stooling usually occurs mainly in the fall, it may also continue in the spring, especially when there is a light stand due to winter killing, etc.

It will interest the history class to know that the Hessian fly was first found in the United States in 1779 near the landing place on Long Island of the Hessian soldiers, who were hired by King George III to help subdue his rebellious colonists. Undoubtedly this little fly, which has generally been charged to them, did far more damage almost at once than did the soldiers themselves.

At this time of the year it will be possible to learn whether the fly is working on the wheat. The fall brood begins to lay eggs early in September on the volunteer wheat and volunteer oats; also on the new wheat when it has been sown so early. The old stubble is filled with spring brood which at this time are in the flax seed stage. This makes it important to see to the destruction of all the old stubble and the volunteer wheat and oats, since that will end the fall brood altogether. Where left they are present in the spring for continued damage.

The adult fly is a tiny, long-legged gnat, not very different from the gnats common to the wheat fields. The egg which is usually deposited upon the upper surface of the leaf close up to the stem is very small and barely visible. These eggs hatch slowly in dry weather, but come on quickly after a rain. The larva or maggot stage passes with little attention from the farmer, since they are very small and quickly pass down into the stem of the plant. Here the maggots feed, grow, reach maturity as maggots and pass into the pupa or flax seed stage, in which stage they usually pass the winter. In Indiana there are two broods, one in the spring and another in the fall. It is the maggot stage that damages the wheat. This damage is done in the fall from the summer or fall brood or in the spring from eggs deposited by the spring brood.

The wheat affected in this way is first a darker green and then becomes yellow. It fails to fill with grain and may die. The best way to control the fly has been suggested as, first, burn or plow under deeply the old stubble; second, destroy all volunteer wheat and oats, so that the eggs will not be deposited in time to reach the pupa stage before winter; third, sow your wheat after the "fly free" date.

The need of coöperation among farmers should be urged in the matter of late sowing and control of old stubble, etc., since one farmer may cause damage to a whole neighborhood by failing to take precautions.

B. It was stated in the lesson on wheat seeding that if the growing season was cool and moist the plants would produce extra shoots and thus make a thick stand. It has been often observed that wheat which has been somewhat winter-killed and this followed by a damp, cool spring, that the wheat crop was almost as good in yield as where a thick stand of plants lived through the winter. This good yield is due to the fact that such plants as remain behind produce several stems to each plant and consequently give almost as thick a stand as if only one or two stems had been produced from each seed sown. The production of extra shoots is called stooling; sometimes the term tillering is used. These extra shoots appear in other plants besides wheat. Oats, rye, and barley and in fact all the grasses produce these extra shoots. In the case of corn they are called suckers. The stooling of wheat or rye may take place in the autumn as well as in the spring. Frequently most of the stooling is done in the autumn.

Late in the autumn is the time to look for the presence of the Hessian fly. As sated in a previous lesson, the Hessian fly lays its eggs early in September on wheat plants, if they can be found. The eggs are laid on the upper surface of the leaf and soon hatch. The young insect does not have any legs and resembles a maggot in appearance. It wriggles itself down the blade to the base of the sheath. Here it absorbs the juices from the plant and causes an unthrifty condition of the plant. The plant usually produces some extra shoots to offset the harm being done to the main shoot by the insect. After living for a short time in this way the larva changes to a flat, brownish condition. This is called the pupa state. In this condition it remains through the winter. In the spring this brown pupa hatches out into a small blackish fly. This is the adult insect. This fly soon lays eggs again and we have the process repeated. It thus happens that wheat may be attacked by the fly both in the autumn and in the spring. Usually the spring attack is worse than the autumn attack because there are so many more insects.

December, 1916.

Rotation.

I. Method of Procedure.

Demonstration Exercises—

1. Plot a farm into fields and plan a fixed rotation scheme. Follow this through for several years. Repeat this exercise for other farms of different sizes and take typical farms in the neighborhood.

2. Draw a plan of the home farm, noting the size of the fields and mark the crops which have been grown during the past five years. Compare with the ideal relation in Exercise 3.

3. Have plans drawn showing ideal arrangement of the farm with proper rotation for the next three years.

II. Points of Information.

Definition—Examples—Points necessary to observe in the selection of crops, viz., adaptation to climate, labor, market—A good rotation should have a soil cleansing crop, soil renovating and a money crop—The Norfolk rotation; the Terry rotation; the corn belt rotation.

A. Study the reasons for a rotation of crops. Get ten or twelve good reasons and note that soil fertility is not improved by rotation alone. This discussion should have plenty of time and both sides of the question should be considered.

The essentials of a good rotation are that it should contain (1) a cultivated crop like corn and potatoes to kill the weeks, (2) a cash crop, (3) a legume to act as a nitrogen gatherer, (4) a crop to furnish feed for live stock.

One crop might be classed in more than one of these groups. In fact a crop like soybeans might cover all these groups.

Note some of the successful rotations in other countries and other times. Would a rotation that was successful in England, where roots are fed largely to live stock, meet the requirements of the corn belt?

Study especially the corn belt rotation of corn, oats, wheat and clover and modifications of this order. Try to improve either the order or the choice of crops. When clover fails what should be done to hold the rotation?

Explain the Toxic Theory. (See F. B. 257, pp. 13 and 31.)

B. A rotation is the growing of crops in a systematic order. Usually three or four crops are grown in a series. A common farm rotation is corn, wheat, and clover, each crop occupying the land during a season and following each other in the order named. The kind of rotation practiced in any given section is determined by the climate, labor supply and market facilities, and to some extent the character of the soil. Crops which require long seasons for maturing cannot be grown in northern climates. Crops which require a great deal of hand labor can be grown extensively only in those sections where abundant and cheap labor can be easily had, as for example, the growing of sugar beets for sugar production. Again, unless it is possible to market the product easily and quickly, a crop suited to the soil and climate may not be a profitable one. Sometimes the farm is located at a distance from the shipping point and this shipping point is also at a considerable distance from a big market.

There are three rotations which have become more or less noted.

1. Norfolk rotation. This is one of the oldest systems of cropping and has been extensively used in Great Britain. It consists of four crops, turnips, barley, clover, and wheat. An examination of this rotation in relation to our climate and labor supply would indicate that it is not suited to Indiana.

2. Terry rotation.—This rotation was originated by Mr. T. B. Terry, of Ohio. It consists of potatoes, wheat, and clover. It will be noticed that in this rotation the ground needs to be plowed but once in three years, and that there is a clover sod for the potatoes.

3. Corn belt rotation.—This consists of four crops, corn, oats, wheat, and clover. Frequently either the wheat or oats is omitted and the rotation becomes a three crop one. This rotation is practiced throughout all the central states in which corn is extensively grown.

The reasons for practicing a rotation are briefly as follows:

1. The different crops draw upon the plant food in the soil in unequal amounts.

2. The root systems have different characters. Some are near the surface while others extend deeply into the soil.

3. Some of the crops in the rotation use nitrogen while others gather nitrogen and leave it in the soil for future crops.

4. The rotation helps the farmer to hold in check weeds, insects, and plant diseases.

January, 1917.

Cowpeas and Soy Beans.

I. Material and Equipment.

1. A few specimens of these plants should be collected for class use if accessible. They may be taken from some hay in the neighborhood possibly.

2. Interest will be increased by getting from dealers in seeds as many varieties of the seed of both cowpeas and soy beans as possible. Collect in glass bottles so they may be seen without handling.

II. Method of Procedure.

a. Demonstration Exercises—

Study dry specimens. Also secure the seed of both of these crops. Note the different varieties of each. Secure as many as possible. Determine amount of each of these crops grown in the community. For what purpose are these crops grown?

III. Points of Information.

The cowpea has been raised in the Southern States for some time but is not very well known as yet in Indiana. Both cowpeas and soy beans have come into much prominence in the last few years since there has been so much trouble in getting other legumes, particularly the clover upon which the farmer had depended. It is important that when clover fails another legume should take its place. These crops are worth special study. They may be used for seed crops, forage and hay crops and soiling crops. They have also considerable range of adaptability of soil. You will note that soy beans will grow upon almost any good corn soil but that cowpeas do best upon a sandy loam.

Note the seedbed is about the same as for corn and either fall or spring plowing is practiced. The soil should be limed for soy beans especially, but the cowpeas will grow upon slightly acid soil.

The time of sowing and quantity of seed will depend upon the purpose of the crop. If the crop is to be harvested for seed or is to be used for hay the seeds should be sown as early as May 15 to June 1. When used as a soiling crop the seed may be sown as late as July 15—thirty pounds of seed for rows 24 inches to 32 inches apart and about 60 pounds where drilled solid. The latter case is when the crop is for hay or soiling.

Inoculation is necessary for the same reason as in the case of alfalfa. The bacteria used by these crops as nitrogen-fixers are different bacteria than are used by the clover plant and so must be introduced into the soil. One bushel of soil is sufficient for eight times that quantity of seed where the soil is distributed with the seed in the drill.

The varieties of cowpeas usually grown in Indiana are Whippoorwill, New Era, Michigan Favorite and Early Blackeye. The varieties of soybeans most common are Early Brown and Ito San in the northern part, and Holly Brook, Sable, Mikado, Black Beauty and Medium Green for the remainder of the State. The last named shatters easily, a rather common fault of many varieties. The seed used should be Indiana grown if possible, and in general should be raised to the north of us rather than south, in order that early maturing qualities may be maintained.

A leaf disease often results from cultivation of these plants in the early morning before the dew has evaporated.

These crops are of Asiatic origin and have been grown and used in that part of the world for a long time. They are comparatively recent crops in Indiana. Only within the last few years has interest in their growing been widespread. The two crops have quite similar characteristics. Both are legumes and good for soil improvement as well as excellent feed. They are well adapted to ordinary corn land. The cowpea will grow on sandier soil to better advantage than the soy bean. The same is also true with regard to the heavy soils like clay loams. The seed bed should be prepared the same as for corn. The planting is done in the spring after corn planting. The seed may be distributed in rows 24 inches or more apart or drilled solid like wheat. When sown in rows cultivation should be given the same as corn. The seed can be distributed with an ordinary wheat drill or with a corn planter. In using the corn planter, special soy bean plates should be used. If these crops have never been grown before on the land, they should be inoculated the same as described before. When using the corn planter, inoculating soil can be mixed with the seed and distributed in that way very effectively.

If these crops are to be used for soil improvements, it is economical to pasture them down before plowing under. Hogs will derive more benefit from the pasturing than other animals.

Soy beans are ready to cut for hay when the pods are about two-thirds grown and before the leaves have begun to turn yellow. Cowpeas are ready to cut for hay when the first pods begin to show

ripeness. Soy beans are ready to cut for seed when they are fully ripe and the leaves have fallen off; cowpeas, when the maximum number of pods are ripe, and before the early ripening pods have begun to burst open. Both cowpeas and soy beans make excellent hay for all kinds of livestock.

Both cowpeas and soy beans may be sown after wheat has been removed, especially in the southern half of the state. If they can be sown by the middle of July and favorable weather conditions result, a good growth will be obtained, sufficient to pay for the cost of the seed and labor. These crops sometimes are sown in standing corn and furnish organic matter for plowing under for the next crop.

February, 1917.

Oats.

I. Material and Equipment.

1. As many varieties as possible should be secured from dealers or others.

2. Blotting paper and plates or some other arrangement for germination.

II. Method of Procedure.

a. Demonstration Exercises—

1. Hull some of each variety and note the different weights and thickness of the hulls.

2. Make germination tests, counting the grains and taking careful notes on all the work.

3. Secure a number of varieties of oats in the community and study same, noting difference in size, color, thickness of hull and presence of beards and long points on the grains.

How many acres of oats will be sown in the community? What is the average yield of oats per acre? Which method, broadcasting or drilling, is used?

III. Points of Information.

A. The oats crop in Indiana has about the same acreage as wheat but ranks below that crop usually in value. It is very important to our farmers because of the ready adaptability of oats to the corn belt rotation. It requires little attention and will grow on nearly all varieties of soil, although it does best on the heavier types of soil. There is great variety of yield, ranging from a few

bushels to 60 and 70 bushels; and even 150 to 200 bushels per acre have been recorded in the Rocky Mountain States. In Indiana the yield will improve with a little more care taken in "getting in" the crop or particularly in preparing a seed bed. Where the seed is sown upon the snow in February or thrown broadcast over the hard ground without any disking before the sowing, the farmer is depending upon favorable rains to do his work for him. If the rains come in season, he often gets a good crop, but again he often fails to get a crop when he could have one with a little more work. This does not mean that the ground should be plowed, for generally the disk harrow will get the ground in good shape. In dry seasons it pays to drill, but of course one can not tell whether a season will be dry at oat seeding time.

The oats should be seeded as early as the ground can be prepared, since cool, moist weather is best for their growth. Farmers vary much in the quantity of seed used, but in general 2½ bushels per acre will be found about right. Compare the stooling habits of wheat with oats and the seed sown. The varieties that seem to do best in Indiana are the Big Four, Silver Mine, Napoleon, Great Dakota. These are spring varieties. The winter varieties grown in the Southern States are usually gray or black. There is a marked preference in the market for white oats.

Some attention can be paid to the smut in oats if there is time. Find out what the disease is, and the treatment, from Purdue Cir. 22.

B. The oat crop is quite generally grown in Indiana. It is a more certain and profitable crop in the northern half of the State than in the southern half. It is greatly influenced by the climatic conditions of the growing season. In cool, moist seasons the oat crop is a very satisfactory one but in seasons of high temperature and small amounts of rainfall, the yield is usually less than enough to pay the expenses of producing.

Most of the oats in Indiana are spring sown and are usually sown on land that was in corn last year. The seed bed is usually prepared by disking and harrowing. When so prepared the seed is distributed by drilling. In many cases the oats are sown broadcast with an end-gate seeder or other means of broadcasting. The seed is then covered by disking and harrowing the ground. The broadcasting method is adapted to cornstalk land where the stalks would be in the way of drilling.

The amount of seed sown varies greatly. Some farmers sow as little as 1½ bushels to the acre, while others sow as much as 4

bushels. The majority of farmers, however, sow from 2 to 2½ bushels to the acre. It is desirable that the seed be run through a fanning mill and that all the light grains and chaff be removed.

Oats are usually not fertilized. Fertilizing will show an increased yield but since the crop is a low priced one per bushel, the increased yield may not pay for the fertilizer.

In some of the southern counties of the State winter varieties of oats are sown about the first of September. These live through the winter and produce good oats next spring. However, in severe winters there is likely to be large loss from winter-killing.

Occasionally a farmer sows oats in February on the frozen ground. Sowing at that time requires no seed bed preparation. If a damp spring follows, this method of sowing usually gives satisfactory yields, but in dry seasons the sowing is a failure.

There are many varieties of oats. The following varieties are quite well adapted to Indiana conditions: Silvermine, Big Four, Great Dakota, Swedish Select, Joannette. A medium early maturing variety seems to be better for Indiana than the very early maturing or late maturing ones.

March, 1917.

Potatoes.

I. Material and Equipment.

1. Secure a few potatoes from each home and get as many known varieties as possible.

II. Method of Procedure.

Demonstration Exercises—

1. Group the varieties into Early and Late.
2. Study the form, size, character of the skin and texture.
3. Study buds (eyes) and note number and depth. Have some pupils try experimental plats to report in the fall. Have whole potatoes, small potatoes, thin cuttings, etc., tried in these plats.

III. Points of Information.

Potatoes are native to Peru and Chili, where the Spaniards found them growing. It was introduced into Ireland in 1586 and soon became so important an article of food that the common name "Irish" was applied.

It is fairly well known that a well-drained sandy loam well

supplied with organic matter is best adapted to potatoes. Yet a fair return can usually be had on a considerable variety of soils. Note the method described in Ext. Bul. 30 for planting the crop. Deep ploughing and a five or six-inch furrow with the seed planted about two inches is recommended. Medium sized potatoes are the desirable ones and hence the seed should be of that size.

Early varieties such as Early Ohio, Early Rose, Irish Cobbler should be planted usually before April 15. The late varieties represented by Rural New Yorker, Sir Walter Raleigh, Carman and Burbank are planted by May 15 and sometimes later.

Notice the general instructions for destroying the potato bug. A mixture of Bordeaux mixture and Paris green will serve as a spray that will kill the two most common insects that infest our potatoes. Purdue Leaflet No. 29 tells you how to make Bordeaux mixture.

Potatoes are adapted to a wide range of soils but grow best on sandy loam soil, well drained, and well supplied with decayed organic matter. The seed bed should be prepared by deep plowing, as deep as 8 or 9 inches. In Indiana potatoes are planted "early" or "late." Early planting means not later than the middle of April while late planting means about the middle of May. It is best to put the seed pieces in furrows four or five inches deep. The seed piece should be covered with about two inches of soil and when the potatoes are up, the furrow is filled by the cultivation given the potatoes. It is desirable to have the seed pieces four or five inches below the level of the surface for the new potatoes are formed above the seed pieces. If the seed piece is planted shallow, the new potatoes will likely stick out of the ground and become green, thus spoiling them for table use.

For seed pieces, one should select medium sized potatoes and cut them in about four pieces so that each piece has at least two buds. A good seed potato is of medium size, smooth and proper shape for the variety, with a corky, netted skin, indicating good maturity. It requires about fifteen bushels of potatoes cut in quarters to plant an acre, if the rows are three feet apart and the pieces dropped 12 to 15 inches apart in the row.

Potatoes should be cultivated the same as corn and until they begin to blossom. The cultivation should be shallow and level.

There are two insects that attack the potato plant. The first to appear in the early summer is the Colorado potato beetle. Later in the season the blister beetle is very destructive to the tops. Both of these insects can be controlled by spraying with arsenate of lead

or Paris green. Potatoes are also attacked by the blight. This can be controlled by spraying with Bordeaux mixture. It is probably best to mix the Bordeaux mixture and the Paris green and by one spraying save the potato from both the blight and the insects.

April, 1917.

Corn Cultivation.

I. Material and Equipment.

1. A few of the tools, particularly the two-horse cultivator, in common use in cultivating corn.

II. Method of Procedure.

a. Demonstration Exercises—

1. Make a study of the adjustments for deep and shallow cultivation, weight of driver, width of rows. Study also the two-row cultivator.
2. Study the two purposes of cultivation and make out a plan that will serve this end. See if implements are the best possible. Take one apart and put together again.

III. Points of Information.

Object of cultivation—Use of harrow—Depth of cultivation—Number of times to cultivate—Use of mover wheel or drag late in season.

There are two objects in cultivating corn:

1. To destroy the weeds which would take up moisture and plant food.

2. To make a mulch of loose soil one or two inches deep on the surface to conserve the moisture. It is some times necessary to cultivate in order to loosen the soil but if the breaking has been well done and there has not been excessive rainfall, this should not be necessary.

Cultivation usually does not begin until after the corn is two or three inches tall. However, time can be saved and effective work done by harrowing the field with a spike-tooth harrow before the corn comes up. This harrowing will also tend to break any crust that may have formed and permit the corn to come up more uniformly. The kind of tool to use in cultivating is not as important as the way in which it is used. It is desirable that the cultivation

should be shallow after the first and second times and that it should be level cultivation. Shallow cultivation is usually thought of as being about $2\frac{1}{2}$ to 3 inches deep, while deep cultivation is more than 3 inches deep. Corn should be cultivated often enough to destroy the weeds and to preserve a mulch. This may be three or four times and it may be six or seven times. It is usually desirable to go through the corn once or twice after it is too large to go under the arch of the cultivator. For such cultivation a harrow-tooth cultivator may be used but care should be taken that the outside teeth do not cut too deeply. It is frequently better to use a drag of some kind. Many farmers use a mower or corn planter wheel or make a short plank drag. The drag breaks the crust on the surface and leaves a nice loose mulch behind.

Locate, if possible, in the community a two-row corn cultivator. Compare this with the single row or two-horse cultivator.

How many times does the average farmer cultivate his corn? Secure as far as possible the first day and the last day of cultivation.

The study of agriculture has done much to change the plan of corn cultivation. It is no longer so common to go into the cloddy field just as the corn is getting through and try to plow the corn. The clods if they exist at that stage should be rolled and the spike-tooth harrow applied until the corn is two or three inches high, when the cultivator will be much easier to use.

Note the two uses for cultivating corn. Of these the conservation of moisture needs most emphasis. We usually try to keep the weeds from "choking down" the corn, another way of saying that the weeds are consuming the plant food intended for the corn, but it is not so certain that we keep the crust broken and a good dust mulch on top. The past two seasons in Indiana have done much to give our farmers training in the uses of the dust mulch in conserving moisture. We are sometimes told that a third purpose of cultivation is aeration of the soil, but this does not cause any change from the two given.

Shallow cultivation has finally won all farmers to its practice. The roots of the corn gradually occupy about all the space between the rows and the later plowings will do much harm unless the farmer keeps on top of the ground or nearly so. The season may require very frequent workings of some sort to keep the weeds down or the mulch prepared, or a dry season will need but a few plowings or workings, hence there is little to be said about how many times the corn should be plowed.

ANIMAL HUSBANDRY.

Seventh and Eighth Grades.

September, 1916.

Judging Draft Horses and Feeding Livestock.

Outline of Study—

Give the pupils instruction regarding the Draft type—the work of the draft horse and his essential characteristics. (Weight, height, conformation, quality, disposition.) The best representative horses of the neighborhood should be used for illustration and actual demonstration. The score card should be explained and its uses demonstrated. The pupil should then be given opportunity of scoring draft horses and having his score criticized and compared with that of the instructor. The characteristics and causes of the common unsoundnesses should be considered.

A complete inventory of farm rations being fed at home to all the different classes of farm animals should be made by each pupil. This should consider the feeds fed and approximate proportion by weight of each in the ration.

Note: The work in judging must necessarily be very elementary with pupils of the Seventh and Eighth Grades.

1. Material and Equipment—

A score card in the hands of each pupil.

One or more horses of draft type accessible to class.

A collection of feeds common in the locality and supplemented by oil meal, cotton seed meal and gluten feed.

Where convenient one or two bones from the skeleton of the horse could be used to advantage in studying unsoundness. Where these can not be had, drawings and pictures should be used freely.

2. Demonstration Exercises—

1. Secure a good representative collection of feeds, as shelled corn, corn meal, corn and cob meal, gluten meal, gluten feed, corn bran, oats, oat meal, oat middlings, oil meal, cotton seed meal, roughages where they can be handled.
2. Most of the work in scoring and judging unsoundness must be in laboratory excursions to the horses or by having them brought by the school grounds, if that arrangement can be made.

Purdue Circular No. 29 is the basis of the work. The score card is in this circular with explanatory material.

A part of the year's work in Animal Husbandry will be the use of the score card and the scoring of different kinds of farm animals. The score card furnishes a training of the eye and the judgment by seeing details. It is a means to an end. It is not an end in itself. To see a horse accurately, the pupil must see details and then be able to sum up an accurate judgment of the whole.

Make a list of the kinds of work required of farm horses and particularly of the farm implements that horses are compelled to draw. Is the tendency of modern farm machinery to become lighter or heavier? Compare the old plow with the gang plow, the double shovel with the two-row cultivator, etc. What is the conclusion that must be reached when we picture the ideal type of horse suited to farm work? How do the market demands carry out this idea? Does the average farm have horses too heavy or too light? Which type of horse is most economical of barn space and feed? Compare a two-ton team with four horses weighing 1,000 pounds, in this respect.

The aim should be to have the pupil reach the conclusion that draft horses are both better adapted to the work of the modern farm and will also meet the demands of the market. In general farm work, which is of greater importance, strength or action? What is draft conformation? Will the horse of draft conformation be of necessity sluggish in action? What size and height are most desirable? What is quality? What is quality of bone, quality of hair, quality of skin? Why is disposition important?

Though there may be no good draft horses in your neighborhood, score the actual horse. It is not necessary to have a perfect horse as a model.

Give some attention to unsoundness. Purdue Circular No. 29 gives a list on pages 35 and 36, and the common ones like ring bone, spavin, etc., should be learned carefully and accurately.

Make the study of feeds a practical one. Put most time on the feeds common to the neighborhood. Study the purpose of feeding. What has feeding to do with growth and conformation? It is not necessary to make an analysis of food constituents in the list of feeds prepared, since this will be done later, but the fattening qualities of corn, the tissue building qualities of legume hay and such concentrates as linseed oil meal should be learned. Distinguish concentrates from roughages. Why are roughages

needed? What concentrates and roughages are best adapted to supplement corn as feed? Remember that in the corn belt, corn should have as large use as possible, but it must be used wisely.

See that the pupil does the work, rather than have the teacher do it for him. Insist that the inventory of feeds is the home list. Connect the work with the actual home conditions and the practical value of this study will be increased.

October, 1916.

Scoring Light Harness Horses.

Outline of Study—

Proceed in the same manner as when scoring the draft horse. Not so much time should be spent on the light harness horse as on the draft horse. Instruction in determination of age of horses under 6 should be given.

1. Material and Equipment—
   Same as previous month except that the feeds will not be continued.
2. Demonstration Exercises—
   1. Have several horses accessible for study at different times. The common farm carriage horse rather than the fancy roadster or racing type should be studied.
   2. Give plenty of time to examination of the mouths of horses when studying age, in the case of ages already known and when the age is not known.

The light harness horse has a different purpose from that of the draft horse. This purpose should be emphasized. The draft horse is the business horse of the farm; the light-harness horse is the errand or pleasure horse. More time should be given to the study of the former than to the latter. Study the differences in conformation of light harness and of draft horses, especially in feet and legs.

In studying age, some exceptions to the pictured characteristics will be found, but familiarity with the subject will enable the teacher to note these.

For more detailed questions and suggestions, see the study of draft horse.

November, 1916.

Scoring Beef and Dairy Cattle—Functions of Different Classes of Matter in Animal Body—Nutritive Ratio.

Outline of Study—

After contrasting the beef type with the dairy type each should be studied separately according to the procedure suggested for draft horses. The time devoted to any one type should be determined by the number in the community which is available for use. The general functions of each class of matter in the animal body should be made plain to the pupil, especially as building material for muscle, bone and fat. The pupil should be taught how to figure the nutritive ratio of a feed or ration, and its meaning and use made clear. The meaning of a "standard" ration should then be made clear.

Functions of Different Classes of Matter in Animal Body.

1. Material and Equipment—
    1. Score cards of beef cattle and dairy cattle.
    2. Picture of the beef and dairy types of cattle.
    3. One animal of each type, if no more is possible, should be accessible to the class.
2. Demonstration Exercises—
    1. Use score card on the animals, going to them or having them brought to the school.
    2. Make up as many problems as will be needed to understand the "nutritive ratio" and "balanced ration."

The type of problem to use may be varied. The nutritive ratio is the ratio between the digestible protein and the digestible carbohydrates plus the digestible fats. This ratio may be found by multiplying the per cent. of digestible fat by 2.25 to reduce it to terms of carbohydrates. Add this product to the per cent. of digestible carbohydrates, which gives the total carbohydrates. Divide this sum by the per cent. of digestible protein:

$$\frac{(\text{Digestible fat} \times 2.25) \times \text{Digestible carbohydrates}}{\text{Digestible protein}} = \text{Nutritive ratio.}$$

It will be seen that the same general plan of scoring cattle may be followed as was made for horses. The conformation of the beef cattle is in some respects like that of the draft horse, while the temperament and disposition are yet more alike. The dairy cow has the nervous temperament of the light harness horse.

Put most time on the type of cattle considered most important in the section.

The series of feeding experiments at Purdue and other experiment stations offer many rations for beef cattle that may be compared. The use of silage for both beef and dairy cattle has shown that feed to be most economical and satisfactory.

Do not spend much time in explaining the German or other standards that may be consulted. The practical standard is one that gets results and must depend upon the watchful care of the feeder. Standards are helpful as guides for experimental feeding.

It would be well to do as much work in judging as possible in November and continue the problems and study of feeds in the stormy days of the winter.

December, 1916.

Composition of Feeds.

Outline of Study—

The teacher should illustrate the general classes of matter contained in feeds. The pupils should then be taught to use the feed composition tables. (Farmers' Bulletin No. 22.)

1. Material and Equipment—
    1. Representative feeds illustrating the constituents of the composition tables. The common feeds may serve.
    2. Copies of composition tables.
2. Demonstration Exercises—
    1. Drive off water from a spoonful of corn meal and burn the matter to ash.
    2. Protein may be found as gluten by washing dough of wheat flour to a sticky mass.
    3. Fat may be shown in the cream or butter, while carbohydrates are a broad class of which sugar is fairly representative.
    4. Work problems.

Feeds give different results owing to their difference in composition. Farmers should learn that no one feed is well adapted to be used alone. Feeds like corn are fattening, other feeds build up bone and muscle. Have a copy of the food composition tables in the hands of each pupil. Note most of the common feeds of the farm in this table, and have the pupil able to give the analysis of different quantities of these feeds.

January, 1917.

Study of Breeds, Their Characteristics and Origin, and Feeding Horses.

Outline of Study—

Make a study with the pupils of the characteristics of the pure bred or registered horses in the community. Consider color, form and other characteristics. A simple story of the origin of each breed should be told the pupil by the teacher. This should consider (a) place of origin, (b) general conditions of the environment, and (c) their present general distribution and number. Make this very elementary.

Material and Equipment—

1. Have pupils prepare a list of the breeds represented by the horses in the community, either pure-bred or grades.
2. The history of the different breeds as given by Plumb or Harper.
3. Pictures and cuts of horses of different breeds.
4. A few animals should be accessible to the class for laboratory work.

Demonstration Exercises—

1. Have a computation made of the proportion and quantities of different feeds that would be fed to a working horse of 1,800 pounds weight for a period of one month.
2. Have a similar exercise for a brood mare with colt at her side, a colt at weaning time, an idle horse, a driving horse working two days per week.
3. Have the pupils make observations and report in writing on the characteristics of the pure bred or registered horses in the community. Have the pupils keep a record of four weeks of the kinds of feed and the amount of each fed to the different classes of horses at home—working horses, weanling colts, brood mares, idle horses. Compare the rations used with the proper ration for each class.

Some reasons should be given for the prevalence of one breed in the community. The topography, the character of the soil, the type of farming, the kind of roads may influence this choice or it may be only the influence of certain breeders.

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Use the pictures as the origin of the breeds is developed. Give special attention to the breeds in the neighborhood and make the pupils familiar with the distinguishing characteristics of these breeds.

After the list of feeds common in the community is discussed, additions to the list may be suggested, giving reasons why they should or should not be given a trial. Work out the nutritive ratio of corn and timothy hay in definite quantities and compare with the balanced ration as described in F. B. 346.

February, 1917.

Feeding Cattle.

Outline of Study—

Proceed as in the study of horses in the outline for January. After a study is made of cattle rations in general (fattening steers, beef cows, milking cows, etc.) study the feeding and development of the calf to maturity.

Material and Equipment—

1. As in January, have a list of the breeds of cattle that are kept in the community, both beef and dairy cattle.
2. Pictures and cuts as before.

Demonstration Exercises—

1. Compute best ration for a yearling steer, a three-year-old steer, a milk cow, etc.
2. Compute the daily gains made by a calf fed skim milk, whole milk, running with dam, getting figures from the work that may be going on at home or in the experience of the class. Try to get some experiments started along this line.
3. Show by assumed conditions that protein feed may be supplied more economically in the form of oil meal or cottonseed meal under some conditions while again clover hay or alfalfa should supply protein. The ration should be ideal only as it fits the situation.
4. Have the pupils make observations and report in writing on the breeds of cattle in the community. Have the pupils keep a record for four weeks of the kinds of feed and the amount of each fed to the different classes of cattle at home—milk cows, fattening steers, beef cows, calves. Compare the rations used with the proper rations for each class.

More cattle should be fed in almost every community for the benefit of the soil and the profit resulting. Keeping this in mind, try to bring the subject of cattle feeding before the class in a way that will make them see this need. Market demands and market quotations with a diminishing supply of cattle show the need of more cattle as well as the profit in cattle. Gains are influenced by pasturing cattle, age of cattle, followed by hogs, short vs. long feed, skill of feeder, etc. The teacher can be of much help to the community along this line if he studies the situation. The Purdue bulletins on Steer Feeding are the results of feeding along practical lines and should be studied carefully.

March, 1917.

Scoring Swine and Sheep.

Outline of Study—

Give the pupils instruction regarding fat hogs about ready for market, brood sows, sheep about ready for the market and breeding ewes.

Material and Equipment—

1. Score cards for swine and sheep.
2. Some representative animals of different breeds, if possible, for the class to work upon.
3. Pictures as before.

Demonstration Exercises—

1. Score as many sheep and hogs as the class can get time to do. Usually the hogs should have greater emphasis since they outnumber the sheep.
2. A pig club composed of members of the class and others might result from a little encouragement from the teacher. The club work would supplement nicely the class work and afford the best laboratory possible.

The lard type of hogs is most common in Indiana. Learn the differences between the lard and bacon types, also the names of the breeds in these classes. What breed is most numerous in your community? The highest finish in feeding hogs has not usually come from farmers. The ration has not been studied by them sufficiently and the conditions have not been good. A better finish would bring a better price and probably greater profit. The cholera fear has also made farmers afraid to keep their hogs any longer than possible. Develop the ideal of a fat hog or sheep from the score card.

The two types of sheep are Fine-wool and Mutton. Learn the breeds that belong to each. Certain breeds like the Shropshire are sometimes called dual purpose in that they serve both for wool and mutton with good returns in each. Not anywhere near enough sheep are kept on Indiana farms. Note the useful purposes they serve. Discuss the danger from dogs and show that the advantage of a whole community is greater than the individual.

April, 1917.

Feeding Swine and Sheep.

Outline of Study—

Make a careful study of proper rations for fat hogs, brood sows, market sheep and breeding ewes.

Material and Equipment—

1. Several rations that meet the requirements in fattening hogs and sheep. Also the list of feeds from which rations may be made.

Demonstration Exercises—

1. Work out problems as before, showing gains when fed different rations, suggested by class.
2. Work out a satisfactory ration for a growing pig. Note how far this comes from being the actual ration in most cases. Will pigs growing with insufficient protein in their ration be as able to resist disease as where the matter is given proper attention?
3. It may be easy to get some boys to try some experiments in feeding pigs as home project work.
4. Have pupils keep a record for four weeks of kinds of feeds and the amount of each fed at home to the above classes of hogs and sheep. How do rations being fed compare with proper rations?

The general advantages of feeding hogs are in furnishing a higher market for the feed of the farm, particularly the corn. Compare the hog with other animals in economy of gains. Iowa has nearly twice as many hogs as Indiana. Corn has been so common that it has been fed too exclusively both for economy of gains and the disease-resisting power of the hogs. Study the advantages of clover pasture or other forage crops for hogs.

The hot-house lamb is worthy of special study as the most profitable sort of feeding due to the great efficiency of the young lamb in making gains. Sheep feeding, however, may become more general as an industry.

DAIRYING.

Seventh and Eighth Grades.

September, 1916.

Silage and Dairy Feeds.

A. Visit farms on which silos are being filled; note the condition of the corn in respect to its maturity; number of men employed; horse-power of engine used; material used in the construction of silo; diameter and height of silo and its estimated capacity; pack sample of corn in fruit jar, placing cover on tightly and keep in school house; note changes that take place.

B. Make a collection of all grains and concentrates found upon farms in school districts; place the samples of feed in glass jars and paste labels on same, giving name, composition and value; arrange samples in accordance with protein content. Also make collection of home-grown concentrates and compare them with purchased feeds especially in respect to composition; discuss methods of manufacturing of mill by-products, such as bran, linseed meal, gluten feed and hominy feed.

October, 1916.

Feeds and Feeding Terms.

A. Have pupils collect samples of roughages as grown in the neighborhood; discuss them from standpoint of protein content and label them the same as has been indicated for concentrates. Determine the amount of these feeds a dairy cow will consume when in full flow of milk; briefly study the history of crops suitable for the dairy.

B. Discuss the meaning of the terms, concentrates, roughages, carbohydrates, fat, ration, supplements, palatability and bulk; have pupils discuss the feeds collected, using terms as indicated above in classifying them.

November, 1916.

Compounding Rations—Home Herd Records.

A. From samples of feeds collected, compound several rations using home-grown feeds in one set as concentrates and in another set, use mill by-products; determine the amount of various feeds a cow will eat and estimate the cost of various rations.

B. Have pupils keep account of the amount of feed consumed by certain cows in their home herd, using, if possible, one of the rations suggested in the previous exercise; note milk production and estimate the profit of various cows over cost of feed.

December, 1916.

Calf Feeding.

A. Study the conditions necessary for best development of young calves, with special reference to amount and kind of feed required at various ages up until six months old, desirable grain rations for young calves; housing conditions; desirable sanitary conditions; variation in birth weight of calves; make a record of the number of calves grown to the age of six months within some definite area; estimate cost of growing calves.

January, 1917.

Care of Milk on the Farm—Sanitation.

A. Have pupils report in regard to type of milk buckets used, whether or not milk is cooled, manner of handling cream after it is separated; make collection of illustrations of milk coolers and milk buckets.

B. Explain meaning of the following terms, sanitation and contamination, in discussing the conditions for their presence; have pupils make notes concerning contaminating influences in and around the barn; undesirable, unsanitary conditions observed in the production of milk and in the handling of it; note the influence of dirt in the sample of milk. Also the effect of sanitary production.

February, 1917.

Cream Separation.

A. Make collection of names of types of milk separators in school districts; study the various methods of separating milk; compare the efficiency of the shallow pan, deep pan, water dilution and centrifugal methods of separation; make a drawing of the standard types of separator bowls and indicate the course of milk as it passes through and explain factors which are responsible for its separation.

March, 1917.

Milk Testing.

A. Explain to pupils, the economic importance of knowing the per cent. of butterfat in milk; study methods of determining this factor with the special reference to the manipulation of the Babcock test.

B. Give pupils practical experience in operating the Babcock test, having them bring samples of milk from certain cows and, in this way, have them calculate the amount of butterfat produced by various individuals in their home herd.

April, 1917.

Transportation and Marketing of Dairy Products.

A. Have pupils report in regard to form that home dairy products are marketed; make a study of the various forms that the dairy products may be marketed, advantages and disadvantages of each.

B. Make a general review study of the factors of the importance in the development in this industry; its extent in Indiana and in the local county; crops grown for rich production and products manufactured from its production.

POULTRY.

Seventh and Eighth Grades.

September, 1916.

Fattening Poultry.

1. Material and Equipment—
   Fattening crate 3 feet long, 2 feet deep, 17 inches high. Equipped with feeding trough and dropping pan. (Each pupil to make one where possible.) If crate can not be made a pen that is clean, dry and well ventilated will be suitable.
2. Demonstration Exercise—
   1. Each pupil must look into the conditions of poultry at home before good constructive work can be done, and with this in mind a report should be required on the following points:

a. Number and kind of chickens at home.
b. Kind of housing conditions.
c. Kinds and amounts of feeds that are being fed for fattening the poultry before marketing.
d. Health conditions of poultry.
e. Age of chickens.
f. Number that will be sold.

2. Study chickens in a nearby flock for the purpose of studying the points to be considered in selecting chickens for fattening.
3. Require each pupil to build a fattening crate 3′ x 2′ x 17″ or obtain use of pen or coop suitable for fattening.
4. Have each pupil select from home flock 5 or 6 chickens to be fattened.
5. Each pupil should feed the crate of chickens at home in accordance with information obtained through class discussions and field work.
6. Compare rations being fed at home with those recommended. Through class, laboratory and home work, information should be obtained on all the points mentioned under "Demonstration Exercises."

3. Home Projects—

The nature of the work outlined above necessitates laying emphasis on connecting the school work with the practical handling of the poultry at home. Too great emphasis can not be laid on the importance of securthe co-operation of the parents.

4. Suggestions to Teachers—

Success in teaching any such subject as the above will depend largely upon just how much the instructor can get the pupils to do themselves. If the teacher does all the work the results will be a failure. She is the one who guides the pupil and the pupil will get results in proportion to what she puts into it. The teacher must know more than the student and so must keep ahead in the work and apply study, observation and, if possible, experience to the work. Make the instruction suit the local conditions and by actual experience show the value of giving time to this study.

4. Points of Information—

Fattening is essentially a finishing process. It is to improve quality more than quantity. Birds to feed should be healthy, vigorous and in good condition. Surroundings that reduce exercise and insure quiet are best. Two weeks' feeding period is long enough. The birds when penned should first be weighed with crop empty and fed twice daily of all they will eat up clean in 30 minutes. Never leave feed before them for a longer period. A good ration is 2 lbs. cornmeal; 1 lb. ground oats; 1 lb. shorts; 8 lbs. buttermilk. This should be mixed and allowed to sour for 12 hours before feeding. If the birds can be weighed every three days the results will be more interesting. Little gain will be made the first 3 days, but more will be made by the tenth. Milk fattened birds are more juicy and tender than fowls fed in the ordinary way.

October, 1916.

Diseases of Poultry.

1. Material and Equipment—

A louse and a mite mounted on cards. Samples of disinfectants, remedies, purgatives, spray pumps and other things that have to do with diseases and their treatment. Pictures and other illustrative material for showing types of ailments.

2. Demonstration Exercise—

1. Have children report on housing conditions of poultry at their homes, kind and amounts of feeds that are being fed, health condition of chickens, how sick chickens act, some of the poultry diseases that are common in the community and remedies that are being used.
2. Discuss lice and mites, their mode of living and method of reproduction; prevention of reproduction, and remedies.
3. Inspect a poultry house near the school. Emphasize the importance of sunlight, fresh air, freedom from dampness and drafts, proper rations, and sufficient exercise to prevent disease. List the diseases due to poor housing, bad feeding, and lack of sanitation.

3. Home Projects—

The greater part of the demonstration exercises will consist of home work. Secure the co-operation of the parents to the extent that they will not only enter into the discussions with their children and at the community betterment meetings, but will encourage the children to do practical work along the line of prevention of disease among the poultry at home. The best cure is prevention and stress must be laid upon that fact. It seldom pays to doctor chickens and fake remedies should be condemned. Insist on applying the knowledge of sickness in the home and among the live stock to the poultry on the farm.

4. Points of Information—

1. *Destroying Lice and Mites.* *Lice* live and reproduce on the body of the fowl. They breathe through the pores in the sides of their bodies. Any penetrating powder applied to the hen, and worked in onto the lice will close up these pores and kill the lice. Blue ointment in amount about the size of a pea applied to the fluff feathers just below the vent will rid the hen of lice. Dusting must be repeated very often, but the blue ointment need not be applied more than twice yearly.

Mites live and reproduce in the cracks and crevices of the henhouse. They can be destroyed by spraying thoroughly with any coal tar stock dip. This must be repeated in ten to fourteen days in order to catch the nits that hatch.

2. *How to Prevent Disease.* All new purchases should be quarantined for a week or ten days in order to see if disease breaks out. No poultryman should ever sell a diseased bird, and every bird that dies should be burned, not buried. Copper sulphate to the amount of one ounce for every ten gallons of water, will keep the drinking water pure, and free from disease organisms, thus preventing the spread of disease through that channel. Poultry houses should be *thoroughly* disinfected several times a year. The yards and runways should be plowed and planted to crops once or twice a year. All remedies should be

carefully investigated before any purchase is made. This will prevent obtaining quack remedies.

November, 1916.

Class and Breed Characteristics.

1. Material and Equipment—
   All the different kinds of chickens available in the community. Collection of colored pictures from Poultry Publishing Companies.
2. Demonstration Exercise—
   Learn the definitions of class and breed. By considering size, purpose, color of eggs, color of earlobes, size of comb, and looseness of feathering, the class to which each bird may belong can be found. By considering shape and general type, the breed may be identified.
3. Home Projects—
   When class and breed differences have been learned the pupils should bring in a list of the birds at home that belong to the different classes and name the breeds of several. Bring out breeds best suited for laying, fattening, setting, general purpose, etc. The practical value of class and breed characteristics can thus be shown and an impetus given for keeping pure bred poultry. Uniformity of product is the greatest value of pure bred fowls.
4. Points of Information—
   Class. Is an arbitrary classification of fowls according to broad general characteristics. The name is taken from the country in which the fowls originated.
   Breed. A subdivision of class. It is determined by shape. Birds of the same breed maintain similar shape characteristics. "Shape makes the Breed."
   1. *Class Characteristics:*
      A. Asiatic Class. Purpose, Meat.
      Characteristics: (1) Large. (2) Red ear lobes. (3) Feathered shanks. (4) Yellow skin except in Langshan, which may have white. (5) Yellow shanks except in Langshan, which may have white or black shanks. (6) Color of eggs brown. (7) Loose plumage. (8) Slow movers, non-flyers. (9) Not nervous. (10) Fair setters and mothers, but clumsy, and are

apt to break eggs and trample on chicks. (11) Not heavy egg producers. (12) Poor foragers. (13) Small single comb except Brahma, which has pea comb.

B. American Class. Purpose, Meat and Eggs.

Characteristics: (1) Medium size. (2) Red ear lobes. (3) Clean shanks. (4) Yellow skin. (5) Yellow shanks except in Black Wyandottes and Javas. (6) Eggs, brown. (7) Medium close plumage. (8) Active. (9) Not nervous. (10) Good setters and mothers. (11) Fair to good layers. (12) Fair to good foragers. (13) Medium sized, single and rose comb. In the rose comb varieties the spike curves with the head.

C. Mediterranean Class. Purpose, Eggs.

Characteristics: (1) Small in size except the Minorcas and Spanish, which are medium. (2) Ear lobes, white. (3) Clean shanks. (4) Yellow skin except in Minorcas, Spanish and Andalusians, which have white skin. (5) Shanks yellow except in Minorcas, Spanish and Andalusians, which have white or black shanks. (6) Eggs white. (7) Close plumage. (8) Active. (9) Nervous. (10) Non-setters. (11) Good layers. (12) Good foragers. (13) Large single and rose combs. In the rose comb varieties the spike points straight back.

2. *Breed Characteristisc:*

A. Asiatic Class.

1. Cochin—Round and fluffy, short legs and neck, low short tail, high cushion, short back, single comb, two outer toes feathered.

2. Brahma—Body longer than it is deep, rather rectangular in shape. Longer neck and legs than Cochin, but not as long as Langshan. Pea comb, more compact and closely feathered than Cochin. Two outer toes feathered. Heaviest breed of the class.

3. Langshan—Longest legs and highest tail of the Asiatic class. Body shorter than the Brahma. Closer feathered than Cochin. Single comb. Only the outer toe feathered. Smallest of the Asiatic class.

B. American Class.

1. Plymouth Rock—Back longer than Wyandotte and shorter than Rhode Island Red. Sloping back. Always single comb. Little inclined to be rangy.

2. Wyandotte—Bird of curves. Short back, body and legs round like a ball. Very blocky and broad. Always rose comb.

3. Rhode Island Red—Long rectangular body. Long straight back, with tail coming off at a sharp angle. Rather short legs. Tail and head carried low, giving a longer appearance to the bird. Single or rose comb. Always red.

C. Mediterranean Class.

1. Leghorn—Small size. Very graceful. Shorter back and higher tail than the Minorca. Legs yellow. Single or rose comb.

2. Minorca—Larger than Leghorn. Extremely long back and body. Tail carried low. White or black legs. Very large combs. Single or rose comb.

5. Suggestions to Teachers—

It is suggested that pupils learn the different classes and breeds by the use of the characteristics rather than by memory. This will teach the child to learn by deduction and reasoning.

December, 1916.

Identification of Varieties.

1. Material and Equipment—

Same as for November with the addition of different kinds and colors of feathers.

2. Demonstration Exercise—

Learn the definition of variety. By considering color and comb the variety may be identified. Some birds will serve to explain the combs, and charts or feathers will bring out the different color patterns. A neighboring poultry show should be visited if possible.

3. Home Projects—

Have each pupil make a collection of all the different kinds of feathers that can be found with correct names for each. Submit drawings of the types of combs. Bring in a list from home of the different varieties that are found there and in the immediate neighborhood.

1. Indentification of Varieties—

Variety. A subdivision of breed. Variety is used to denote the different colors or kinds of comb that are found of the same breed. Color and comb make the variety.

2. Description of Varieties of Feathers.

Parts of a feather: (a) Quill or shaft. (b) Fluff or under color. (c) Web or surface.

Black. Pure black with greenish sheen. Should be free from purple bars.

White. Pure white. Should be free from creaminess, brassiness or foreign color.

Buff. Rich golden buff. Should be free from shaftiness and mealiness.

Red. Deep mahogany red. Should be free from mealiness or shaftiness.

Salmon. Salmon color. Should be free from shaftiness.

Barred. Grayish white crossed with bars that stop short of being positive black.

Golden Laced. Golden center, oval in shape, in black feather, undercolor slate.

Golden Penciled or Partridge. Mahogany brown penciled with distinct black. The cresentic penciling conforms to the outline of feather. The parallel form running across the feather at right angles to the shaft.

Stippled. Light brown sprinkled over with specks of darker brown.

Striped. Black stripe down the middle of a feather of some other color, usually white or red. The stripe should stop short of the end of the feather.

January, 1917.

Age, Sex and Vigor.

1. Material and Equipment—

Females—A pullet, yearling and 2 year old.

Males—A cockerel, yearling and 2 year old.

2 Females, one of strong vitality, one weak in vitality.

2 Males, one of strong vitality, one weak in vitality.

2. Demonstration Exercise—

Study the characteristics of both males and females with respect to age, finding those things that typify age.

Learn the terms of age, and sex. With the weak birds point out the characteristics that denote poor vitality and show the opposite on the strong birds. Explain the influences of age and vigor upon health, egg production, and hatchability and fertility of eggs.

3. Home Projects—

Ask each pupil to bring in a list of the birds of different ages on the home farm, or in some neighboring flock. List the number of birds in this same flock that are good, fair or poor in vitality. The question of vitality is by far the most important one in the poultry business. With good vigor birds withstand much abuse, but with poor vigor they can not do well under the best of conditions. The ability to produce eggs and hatch them depends largely upon the amount of vitality in the laying stock. The question of vigor has been shown to be of importance in live stock, why not with poultry?

1. *Indications of Age, Sex, and Vigor.*

A. *Age.*

Cockerel—A male bird under one year old.

Cock—A male bird over one year.

Pullet—A female under one year.

Hen—A female over one year.

2. *Indications of Age.*

Head—The comb becomes coarser as the bird gets older. A comb that has been frozen off is usually a sign of a bird over one year old. In old age the ear lobes and face become wrinkled and the eyes sunken.

Shanks and Toes—In the older birds the shanks show a little coarser than in the younger birds. Scaley legs are not necessarily indications of age. In the young male the spurs are shorter and round on the end, while in old males they become very sharp pointed and hard.

Plumage—In old hens the plumage gets dull and more fluffy and loose in appearance. Feathers in general are larger in old birds than in young.

Voice—The voice becomes deeper with age.

Activity—Age brings laziness after second year.

Shape—As age proceeds the birds round out. The breast fills out and the thighs increase in size.

Color—Old birds usually fade in both plumage and shanks.

3. *Indications of Sex.*

Head—The comb is larger in the males. Lopped combs are found in the Mediterranean females. The male has a coarser head and head appendages than the female.

Plumage—One never failing indication in birds from two to three months old and older is that the saddle feathers of the males are sharp pointed, while the females are rounded. The males are always more glossy and in colored varieties, with few exceptions, are more gaudy.

Voice—Males crow and call, females cackle, cluck, and sing. In young birds the female has the higher voice.

Spurs—Mostly found on males, although sometimes found on hens.

Size—The males are larger than the females.

4. *Vigor or Vitality.*

Vigor or vitality is the foundation upon which all successful poultry operations are built, and the lack of which is the cause of many failures. Webster says, "Vigor is force, strength, energy," and "Vitality is life, power."

5. *Indications of Strong Vitality.*

Head—Comb full blooded and full size for age and breed; eye bright, full and prominent. Beak short, well curved and stout.

Neck—Thick and short for breed.

Back—Broad and strong.

Breast—Wide and full.

Shanks—Straight, strong and bright colored.

Body—Wide and deep, showing capacity; wide between legs, deep between points of pelvic bones and rear of keel.

Plumage—Bright and glossy.

General Activity—Alert and active for breed. Masculinity in males and femininity in females. Loud and frequent crowing of the males.

6. *Indications of Weak Vitality.*

Head—Comb pale, small, or lopped in male; eye pale or sunken; back long, slim and straight; face flat and sunken in front of eyes. "Crow Head."

Neck—Long and thin.

Back—Narrow and weak.

Breast—Narrow, flat or shallow.

Body—Narrow or shallow.

Shanks—Long, thin, hard, dry and cold.

Plumage—Dull.

General Activity—Inactive, cowardice; feminine looking males.

February, 1917.

Physical Characteristics of Eggs.

1. Material and Equipment—

2 raw eggs (1 fresh; 1 stale).

2 saucers.

1 boiled egg.

Chart or drawings.

2. Demonstration Exercise—

Break the 2 raw eggs out upon saucers and study the difference in structure and condition.

Peel the shell from the boiled egg, taking care not to injure the egg proper. Cut the egg longitudinally and study the structure.

3. Questions—

What are the different parts of the egg and their uses as food?

What is the difference between a stale and a fresh egg?

What causes staleness?

What is the difference between a fertile and in infertile egg?

Why are yolks of different colors?

4. Suggestions—

Take up eggs as a food and the care necessary before marketing and after purchasing. Eggs are perishable products and easily absorb odors, etc.

5. Points of Information—

Raw Egg:

Thin Albumen: Watery substances around outer edge of egg.

Dense Albumen: Thicker transparent, substance which stands up in thick layer.

Yolk: Yellow portion.

Germinal Disc: White spot which floats to top of yolk.

Vitelline Membrane: Very thin membrane around the yolk of the egg, containing the yolk.

Chalaza: Dense, cordlike albuminous structures at each end of yolk, the function of which is to suspend the yolk in the center of the food supply, the albumen; also to keep it suspended for protection.

In the stale egg the yolk is flat, and in the fresh egg the yolk stands up much higher.

Boiled Egg:

Observe two outer membranes enclosing a small air cell. After the egg is cut the two whites can be easily separated.

Staleness is caused by age or heat, and influences the physical rather than the chemical condition to a great extent. A *fertile* egg contains a fertilized ovum and when heat is applied to it can produce a chick.

March, 1917.

Artificial Incubation and Brooding.

1. Material and Equipment—

   Incubator (loaned by a local firm).

   Brooder (loaned by a local firm).

2. Demonstration Exercises—

   Study the incubator and brooder for the purpose of determining the principles upon which they are constructed. Simple laws of physics can be learned from the regulator.

3. Questions—

   What are the incubation periods for different birds?

   What are the temperatures required each week of incubation?

   What are the advantages and disadvantages of natural incubation? Of artificial incubation?

   What are the methods of artificial incubation?

   Similarity between natural and artificial incubation.

   Study brooder in the same manner.

Emphasize importance of poultry club work.

a. Interests children in home work.
b. Connects school work with home life.

3. Improves poultry conditions and is therefore of economical importance.

April, 1917.

Feeding Chicks.

1. Material and Equipment—
   Feeding troughs.
   Water vessels.
   Samples of feeds (mixed and unmixed).
2. Demonstration Exercises—
   Choose best feeding and watering device that can be made at home. Mix rations from home feeds.
3. Home Projects—
   Each pupil should take a brood of chicks at home and raise them according to regulations laid down especially as to rations. This may be a clutch of chicks under a hen.

HORTICULTURE.

Seventh and Eighth Grades.

September, 1916.

Home Gardens—Vegetable Shows.

Hold a vegetable show, giving prizes or honorable mention for the best assortment of vegetables from the home garden and for best specimens of each kind of vegetable.

Visit several home gardens and have pupils inspect them and score them according to following score card.

Garden No..... Judge.....

	Points.	Score.
Location	5	....
Soil adaptability	5	....
Number vegetables grown	10	....
Garden plan	5	....
Tilth of soil	20	....
Tillage tools	5	....
Freedom from weeds	10	....
Health of vegetables	15	....
Yield	25	....
Total	100	....

Locate several typical home gardens in the community within easy reach of the school grounds. Equip each pupil with score cards and see that every point on the card is understood. The points mentioned are graded according to their relative importance.

Location: With reference to house, water supply and storage cellar.

Soil Adaptability: Is it suited to garden crops or is it too heavy and cold? Are the proper crops growing on the proper soils?

Number of Vegetables Grown: Is there enough variety in crops? Do the crops furnish vegetables throughout the entire year?

Garden Plan: Has any definite plan been followed? Has a system of companion and succession cropping been planned? Is the garden too large or too small for the family to be supplied with vegetables? What about its shape for economic working?

Tilth of Soil: Is soil friable or hard and baked? Has fertilizer been used. Has the soil been cropped to death?

Tillage Tools: Has the gardener proper tools? How are they kept? Are they adapted to his soil?

Freedom from Weeds: Do the vegetables have a constant battle with weeds? Are the weeds present dangerous?

Health of Vegetables: Are the plants infested with plant diseases and noxious insects? Have they been sprayed?

Yield: Does the gardener secure sufficient yield to warrant the use of the ground for this purpose?

Visit a neighboring market garden and have pupils observe and write up methods of harvesting vegetables. Give pupils the yields and income per acre of the principal crops to stimulate interest.

The following study may also be made of special crops:

VEGETABLE STUDY.

Outline of Study—

Several specimens of potato, squash, beets, carrots, cabbage, and tomato. Secure several different types of the vegetables common to the garden at this season and have the pupils familiarize themselves with their gross appearances and uses. Have potato contest at this time as outlined in Purdue Extension Bulletin 20.

What type of potato is most desirable from the market standpoint? What variety of squash is best adapted to storage? How would you store beets and carrots? What insect

and disease pest trouble these vegetables? How are they controlled?

Demonstration Exercises—

Study the different varietal types of the following fall vegetables: Potato, squash, beet, carrot, cabbage, and tomato. Make outline drawing of each. Note how each vegetable is propagated and what it is used for.

October, 1916.

Storage of Vegetables.

School should either buy some vegetables for storage (to be sold again in spring) or get permission to have class store some vegetables for some farmer.

Weigh all vegetables to be stored to compare this weight with their weight when removed from storage to determine shrinkage.

Construct a vegetable storage pit on a well drained site and store some of the root crops, such as beets or carrots or parsnips. Cabbage may also be stored, setting plants in layers with the roots *up*.

Have pupils learn the fall vegetables and vegetables that may be stored for winter use.

November, 1916.

Fertilizer and Germination Tests.

Dig a pit for next spring's hotbed before the ground freezes. Cover with boards to keep out snow. Select a well-drained place for the pit hotbed. A well-drained south slope with wind break on the north side is preferred.

It would be well to include a little agricultural botany this month with some simple laboratory experiments illustrating transpiration; the absorption of moisture by seeds; the action and growth of roots; types of root systems; the plant foods needed by vegetables and the fertilizers containing these plant foods. Try to grow a few plants in pure sand to illustrate starvation due to lack of plant food.

Conduct some simple germination experiments in a warm temperature and in a cold temperature, and with too much and too little water, etc. Test the germination of several kinds of vegetables such as celery, lettuce, parsnips, radish, cucumber, beets, peas, and beans at different depths in the soil. How does the size of seed compare with the depth it may be planted?

December, 1916.

Garden Pests.

Study the life history of the insects injurious to vegetables and how to kill them. Be sure to include, squash bugs, tomato worm, plant lice, cut worms, cucumber beetles (striped and spotted), white grubs, wire worms, corn ear worms, cabbage worms, potato beetles, blister beetles, and as many others as you find of economic importance in your community. Begin this work by telling the pupils something about the general life history of all insects and the changes they go through from egg to maturity. Explain the two ways which insects injure plants and why a poison that kills one will not affect another. Mix up samples of the different insecticides and be sure each child knows the proportions and for what used.

January, 1917.

Diseases of Vegetables.

Make a short study of diseases of vegetables and how to overcome them. Include anthracnose of bean, mildews, potato blight, potato scab, corn smut, and tomato rot. Teach children to make Bordeaux mixture. In order to make the plan of this year's garden correctly it will first be necessary to study the methods of planting, distance apart of rows, habit of growth and distance apart in rows.

GARDEN PLAN.

Outline of Study:

List of vegetables suitable for companion and succession cropping. Lists of vegetable varieties suitable for your particular community. Large sheets of paper such as the better grades of wrapping paper. Rulers and compasses.

Prepare list of vegetables with proper planting distances (see Farmer's Bul. 255).

Have each pupil make a planting plan of his school garden, showing arrangement of rows, approximate dates of planting, distances between rows, varieties selected, amount of seed required, etc. Have pupils study seed catalogues and order seed for their gardens.

What direction will the rows run so as to receive a maximum of sunlight? Where will you locate your perennial

crops? Why? What are the requirements of good companion crops?

The garden, if possible, should include some early or cool season crops grown from seed, such as peas, lettuce, radishes, beets, etc., some transplanted crops such as early cabbage, early cauliflower, some late or warm season crops grown from seed such as beans, cucumbers, etc., and some warm season crops that must be transplanted, such as tomatoes.

Demonstration Exercises—

Make a plan for a garden 50x100 feet. Plan to produce enough vegetables for a family of five throughout the entire year. Use companion and successive crops wherever possible. Use as much horse labor as possible in cultivating, so plan rows accordingly. Select from seed catalog sufficient seed to plant garden planned and make out order.

Take pains to work out a good plan for a home garden and have pupils copy this plan and take it home in an effort to improve the farmer's home garden.

Group the vegetables as much as possible in the order of planting, starting at one side of the garden with the early crops and proceeding across the garden with the later plantings. If the short season early crops have been grouped in adjacent rows they will all be harvested early in the season leaving a large portion of the garden clear so that a succession planting can be made of some late crop.

Group the perennials at one side or one end of the garden.

February, 1917.

Testing Garden Seed.

Open vegetable storage pits made in October. Weigh the vegetables and compare with weights when put in pit and determine loss.

Outline of Study—

Several old dinner plates or pie tins, canton flannel, and garden seeds—both old and fresh. Have each pupil bring two old dinner plates or pie tins lined with a square of canton flannel. Secure several different kinds of vegetable seeds both fresh and at least one season old.

Why is it desirable to test seeds? Which seed germinated the best, the old or the fresh? What are the essentials for proper germination?

Demonstration Exercises—

Make seed tester out of plates by placing layer of moist canton flannel in one plate and counting out 50 of each kind of seeds to be tested. Moisten the second piece of canton flannel and lay it over the seeds. Now invert the second plate over the seeds and set away to await germination. One-half of the pupils will use fresh seeds and the rest old seed. After two days make observation on germination up to the seventh day. Record observations and figure percentage of germination on a table similar to the following:

GERMINATION TABLE.

Vegetable	Variety.	Number Seeds Tested	Date Started.
.....	.....	.....	.....
.....	.....	.....	.....

PER CENT. GERMINATED.

Variety.	2d day.	3d day.	4th day.	5th day.	6th day.	7th day.	Total.
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....

Identification of Garden Seeds.

Outline of Study—

Small vials filled with seeds of the following vegetables: asparagus, bean (several varieties), beet, cabbage, carrot, cauliflower, celery, corn, cucumber, eggplant, lettuce, muskmelon, okra, onion, pea, parsnip, pepper, pumpkin, radish, rhubarb, salsify, spinach, tomato, squash, turnip and watermelon.

The vials for this seed work can be secured from the local druggist or the pupils can collect small bottles at home. Make duplicate sets of samples. Label one plainly with the name of the vegetable and place number on the second set. After the pupils have had opportunity to become acquainted with the seeds in the labeled bottles, substitute the numbered bot-

tles and register the record of each pupil in an identification contest.

Why is it desirable to be able to recognize the seeds of the common vegetables? What seeds do you get confused? Why is this?

Demonstration Exercises—

Learn to identify the more common garden seeds by studying them in labeled bottles. Observe their color, shape, and odor. Draw sample shapes of each kind of seed.

Garden Problems.

Outline of Study—

Originality in the teacher will be shown in adapting practical garden problems of community to this exercise.

Make up several problems such as are given under "Demonstration Exercises," and submit to pupils. Always try to have problems refer as much as possible to local conditions.

Demonstration Exercises—

1. John Smith is going to plant 3 acres of tomatoes. He intends to set the plants 5 x 5 feet in the field. How many plants will he need? (5,226.)
2. It is figured that 1 oz. of carrot seeds will plant 100 feet of drill. My seed tests 75% viable and I want 35 feet of drill. How much seed must I use in order to insure a perfect stand? (44 oz.)
3. Bordeaux mixture is made by the following formula: 4 pounds blue stone, 6 pounds lime, and 50 gallons water. I desire three gallons as a spray for my potatoes. How much blue stone and lime must I buy? (3.84 oz. blue stone, 5.763 lime.)
4. One oz. tomato seed will produce 3,500 plants. John Smith has 2 oz. seed planted in a hot bed and desires to transplant the seedlings into flats (16″ wide and 22″ long) 4 x 4 inches. How many flats will he need? (318.)

March, 1917.

Hotbed Manufacture.

Outline of Study—

New material need not necessarily be used in this exercise. Any planking will do which will allow of a box being made which is rectangular in form, six feet wide, three feet long,

with the back 18 inches high and the front 12 inches high. The glazed sash may either be borrowed from some nearby gardener or purchased outright.

The following material will be needed:

One piece 2″ plank 18″ wide, 3′ long.
One piece 2″ plank 12″ wide, 3′ long.
Two pieces 2″ plank 18″ wide, 6′ long.
One-half pound spikes, several hammers and saws.
One hot bed sash, glazed.

Why are all hot bed frames made with a slope? Why was such heavy lumber used?

Demonstration Exercises—

Build a hotbed frame according to the following dimensions:

Back—1 piece 2″ plank 18″ wide, 2′ 8″ long.
Front—1 piece 2″ plank 12″ wide, 2′ 8″ long.
Sides—2 pieces 2″ plank 18″ wide, 6′ long, and so sawed that they will have a slope of 1″ to the foot. This is done by sawing off a triangular block from each plank 6′ long and with a base 6″ long. Nail these four pieces so sawed into a rectangular box with the sloping surface on top. Nail the long sides onto the shorter ends. It should then have a top outside measure of 3x6 feet, on which the standard hotbed sash will just fit.

References:

Purdue Bulletin, Farmers' Garden.
Purdue Extension Bulletin No. 6.
U. S. D. A. Farmers' Bulletin 255.
Watts: "Vegetable Gardening."
Bailey: "The Principles of Vegetable Gardening."
Lloyd's "Productive Vegetable Growing."

Prepare record sheets for gardens similar to following:

Vegetable.	Variety.	Amount Planted.	Date Planted.	Date First Used.	Date Last Picking.	Total Yield.
.....	.....	.....	.....	.....	.....	.....

The pupils should also keep yield records of their gardens similar to following.

Yield Record.			
Date.	Vegetable.	Amount of Yield.	Value.
.....	.....	.....	.....

Hotbed Preparation and Planting.

Outline of Study:

Ascertain what crop is most grown in the community and attempt to devote whole hotbed to it. If no special crop is given, devote bed to tomatoes, peppers, cabbage, cauliflower, lettuce and radish. Have each pupil sow one drill of each seed so that all may have an interest. Detail squads to tend hotbed each day after planting.

The following will be needed:

Hotbed frame and sash.
Fresh horse manure.
Good friable garden loam.
Vegetable seeds.
Spades, forks, etc.

Why is the manure allowed to heat before being placed in the pit? Why are hotbeds used? What is the difference between a hotbed and a cold frame?

Demonstration Exercises—

Prepare hotbed according to directions found on page 4 of Extension Bulletin 6. Sow garden seeds in drills about 6″ apart. Bed should be ventilated each day and watered when dry. Always water in the morning on bright days so that the plants may have time to dry off before night. When school closes, the plants can be taken home by the pupils and planted in the home garden. They should be observed throughout the season and an essay written on their development and use.

References:

Purdue Bul., "Farmers' Garden."

Extension Bul. No. 6 U. S. D. A. Farmers' Bulletin No. 255.

Watts: "Vegetable Gardening."

Bailey: "The Principles of Vegetable Gardening."

If hotbed can not be built, sow seeds in shallow boxes placed in south window, and transplant later to cold frame, either sash covered or cloth covered.

Tell about varieties in vegetables on account of season, size, etc. Continue the seed study by weighing definite amounts of each kind and having pupils count the numbers of seeds; then find how many seeds in 1 oz., $\frac{1}{4}$ lb., and $\frac{1}{2}$ lb. Rural teachers can weigh the seed or have it weighed some time previous at the village drug store or at the township high school. Count the number of onion sets in a quart.

April and May, 1917.

Cold Frames.

Construct cloth covered cold frame for hardening off tomatoes. About April 1 the garden should be plowed or spaded and worked into a good seed bed. The first planting of cool season crops such as radish, peas, lettuce, onions, etc., can usually be made first week in April.

The second week, beets, carrots, parsnips, etc. can be planted.

The third week the cool season crops such as cabbage, cauliflower, head lettuce, etc., can be set out in garden.

Teach importance of good cultivation and labor-saving method of preparing and cultivating home garden by horse cultivation.

Planting will continue every week or so as season advances, planting according to the plan made in January.

COURSES OF STUDY IN AGRICULTURE FOR THE HIGH SCHOOLS OF INDIANA.

Soils and Soil Fertility.

(18 Weeks.)

(1) Special Topics for Study.

1. *Conditions Necessary for Plant Growth.*
   - A. Essential factors:
     - (a) Moisture.
     - (b) Warmth.
     - (c) Air.
     - (d) Plant food.
     - (e) Mechanical support.
   - B. Essential plant food elements:
     - (a) Those derived from the air (organic).
     - (b) Those derived from the soil (mineral) (plant-ash).
     - (c) Relative proportions from air and soil.
2. *Origin and Formation of Soil.*
   - A. From what are soils derived?
   - B. How soils are formed:
     - (a) Decomposition of rocks.
     - (b) Disintegration of rocks.
   - C. Influences of composition of rocks on character of soils.
3. *Agencies of Soil Formation.*
   - A. Water:
     - (a) Chemical action.
     - (b) Mechanical action.
   - B. Temperature:
     - (a) Heat and cold (expansion and contraction).
     - (b) Freezing and thawing.
   - C. Glaciers:
     - (a) Action of glacial ice.
     - (b) Extent of glaciers.
     - (c) Influence of swollen glacial streams.
   - D. Atmosphere:
     - (a) Chemical action.
     - (b) Mechanical action.

E. Plants and Animals:
   (a) Effect of plant roots and root excretions.
   (b) Earthworms, ants, moles, etc.

4. *Physical Properties of Soils.*
   A. Mechanical Composition:
      (a) Texture of soils.
      (b) Importance of size of soil particles.
      (c) Classification of soils.
         1. How Soils are Named:
      (d) Relation of size of soil particles to
         1. Water in soils.
         2. Plant food.
         3. Air and temperature.
         4. Adaptation of crops.
   B. Structure of soils:
      (a) Meaning of the term.
         1. Granulation.
         2. Flocculation.
      (b) Effect of structure on
         1. Porosity (aeration).
         2. Available water holding capacity.
         3. Percolation of water.
         4. Weight.
         5. General tilth of clay and sandy soils.
   C. Methods of modifying structure:
      (a) Tillage.
      (b) Addition of organic matter.
      (c) Freezing and thawing.
      (d) Drainage.
      (e) Use of lime.

5. *Soil Water.*
   A. Functions of water in the soil.
   B. Amount in soils.
   C. Per cent. of water in green plants.
   D. Amount transpired by leaves to produce one pound of dry matter.

6. *Control of Soil Water.*
   A. How water is lost from soils:
      (a) Percolation.
      (b) Evaporation.

B. How to increase the available water supply of soils:
   (a) By drainage (where needed).
   (b) Increasing organic matter content.
   (c) By tillage.
C. How to reduce the loss of water from soils:
   (a) By tillage.
   (b) By keeping down weeds.
   (c) By increasing organic matter content.

7. *Drainage.*
   A. Methods:
      (a) Tile drains.
      (b) Open ditches.
   B. Effect on soil structure.
   C. Effect on soil temperature.
   D. Effect on soil aeration.
   E. Effect on soil washing.
   F. Effect on available water supply.
   G. Effect on available food supply.
   H. Depth of drains.

8. *Tillage.*
   A. Plowing:
      (a) Parts of the plow.
      (b) Attachments for plow.
      (c) Different kinds of breaking plows.
      (d) Depth to plow (factors which determine).
      (e) Spring and fall plowing. (Effect on moisture content).
   B. Subsoil plowing:
      (a) The subsoil plow.
      (b) Purpose of subsoiling.
      (c) When subsoiling is necessary.
      (d) Best time to subsoil.
      (e) Effect on the absorption and retention of moisture.
      (f) Effect on capillary rise of water.
      (g) Precautions to be observed.
   C. Harrowing:
      (a) Kinds of harrows.
      (b) Use of different types.
      (c) Why the plow should be closely followed by the harrow.

D. Rollers and clod crushers:
   (a) Reasons for compacting the soil.
   (b) Effect on moisture content and capillary rise of water.
   (c) Danger of losing moisture after rolling.
   (d) Why follow the roller with the harrow?
   (e) Kinds of rollers and clod crushers.
   (f) Use and purposes of clod crushers.

9. *Soil Mulches.*
   A. What is meant by a "dust mulch"?
   B. How to establish a mulch.
   C. Purpose of soil mulch.
   D. How a mulch reduces evaporation.
   E. Depth.
   F. Frequency of renewal.
   G. Why ground should be stirred after every rain.

10. *Rotation of Crops.*
   A. Meaning of "rotation of crops."
   B. Why crops should be rotated.
   C. Bad effects of continuous culture.
   D. Use of legume and cover crops in a rotation.
   E. Rotations in your home county.

11. *Organic Matter of the Soil.*
   A. As a source of nitrogen for plants.
   B. Effect on water holding capacity, temperature, and structure of soils.
   C. As food supply for bacteria.
   D. How humus supply is reduced:
      (a) By continuous growth of tilled crops.
      (b) By cropping without grasses or legumes.
   E. How humus may be increased:
      (a) By proper crop rotation.
      (b) Use of farm manures.
      (c) Green manuring.

12. *Farm Manure.*
   A. Production.
   B. Value:
      (a) Chemical.
      (b) Physical.
   C. Care and management.
   D. Reinforcement.

E. Application:
   (a) Season of the year.
   (b) Amount per acre.

13. *Green Manure.*
   A. Meaning of the term.
   B. Value.
   C. Best crops to use.
   D. Precautions to be observed in using.

14. *Commercial Fertilizers.*
   A. Complete fertilizer.
   B. Raw materials.
   C. Sources of
      (a) Nitrogen.
      (b) Potash.
      (c) Phosphorus (phosphoric acid).
   D. Value depends on
      (a) Per cent. of plant food present.
      (b) Relative availability.
   E. Adulterations and fillers.
   F. Home mixing.
   G. Relative cost per pound of plant food.

15. *Lime.*
   A. Reason for use of lime.
   B. Different forms used in agriculture.
      (a) Quick or burned lime.
      (b) Air or water-slaked lime.
      (c) Ground limestone.
   C. Composition of different forms.
   D. Relative efficiency of different forms.
   E. Precautions to be observed in use of quick lime.

16. *Bacteria.*
   A. What bacteria are:
      (a) Size.
      (b) Rate of increase.
   B. Conditions affecting growth and development—
      (a) Aeration. (Character of soil.)
      (b) Moisture.
      (c) Temperature.
      (d) Organic matter.
      (e) Lime.

C. Nitrification:
   (a) What it is.
   (b) Importance.
   (c) Causes.

17 *Inoculation.*
   A. What is meant by inoculation.
   B. Reasons for.
   C. Methods.
   D. Crops which may be improved by.

LABORATORY EXERCISES IN SOILS FOR USE IN HIGH SCHOOLS.

(1) A Study of Soil Types in the Field—

In communities where a variety of soil types exist, located conveniently to the school, pupils may be taken out into the field, and the various types of soil studied. Attention should be called to differences in color, depth of soil and to variations in texture.

The general physical character of the surface soil and the sub-soil should be studied and compared. Time may also be taken to secure samples both of soil and subsoil for later study in the laboratory.

(2) Determination of the Approximate Proportions of Coarse and Fine Particles in Soils—

Samples of sandy and clay, or clay loam soils are desirable for this experiment. Place a small quantity of each sample of soil to be tested in a wide mouth bottle holding approximately a pint of water, or an ordinary Mason fruit jar may be used. Fill the jar about three-fourths full of distilled water if available, (rain water will answer the purpose if distilled water is not available) and shake thoroughly. Allow it to stand for three or four minutes until the coarser particles have subsided, and pour off the muddy liquid. Repeat this operation until the water in the jar is comparatively clear. The finer particles have then been removed and the coarser sandy material remains in the jar. By using a known quantity of soil the relative amount, or coarse and fine material may be readily calculated. In order to do this the amount of fine material will be ascertained by saving the part poured out of the jar, evaporating to dryness and weighing, or it may be determined by difference.

(3) The Effect of Texture on the Capacity of Soil for Available Water—

For carrying out this experiment, ordinary lamp chimneys with a cloth tied over one end, or tomato cans with holes punched in the bottom will serve the purpose. Use several types of soil, such as clay, loam, and sandy. First of all, weigh the container empty, put in about a pint of soil or less and weigh again. Wet the soils until they begin to drip and when dripping has ceased, weigh and determine the percentage of water retained by each type of soil.

(4) The Effect of the Addition of Organic Matter on the Available Water Capacity of the Soil.

A rather sandy soil will be found best for this exercise, although loam or clay loams will answer, using the same apparatus as suggested in Exercise (3). Use one series of soils in the natural condition, and another series containing ten per cent (10%) of organic matter, such as chaff or peat. The latter being preferable. Conduct the experiment in the same way as suggested in Exercise (3). In connection with this exercise attention should be called to the value of carefully saving and applying to the ground all farm yard manure and crop residues.

(5) Showing How Soils May Absorb Plant Food from Solution.

Use soils of different texture, such as sandy, and clay soils, and peat or muck, if available. If the latter cannot be secured, five or six per cent of organic matter may be mixed with sandy soil for the purpose of showing the effect of organic matter on the absorption of substances from solution. Weight out about fifty grams of soil into a small dish and thoroughly saturate with a solution of diamond dye. Stir thoroughly for a few minutes and pour off the liquid from each soil into a small glass funnel containing a piece of filter paper. Collect the filtrate from each sample in a small bottle and note differences in the color of each.

Make the practical application of this exercise to the use of soluble fertilizing materials, and the relative probability of their loss from the different kinds of soil, calling attention to the effect of organic matter in absorbing the soluble substances from solution.

(6) The Effect of Drainage on Temperature of Soils.

Fill a couple of tin cans with soil, one can being provided with drainage by having holes punched in the bottom. The other can without drainage. Wet both soils thoroughly to the point of saturation. Insert a thermometer with a bulb about one inch beneath the surface and take temperature reading from day to day, noting differences in temperature.

(7) The Effect of Slope on the Temperature of Soils.

Where suitable conditions are available temperature readings may be taken on a piece of land having a southern exposure and on another having a northern exposure. Noting carefully differences in the temperature of the soil. The bulb of the thermometer should be inserted from an inch to two inches beneath the surface. This exercise can be very nicely carried out in the spring at the time when the frost is leaving the ground.

(8) The Effect of Drainage on the Germination of Seed.

Proceed as in Exercise (6), but before moistening or saturating the soil, plant a few grains of wheat or corn. Place in a warm, well lighted location and observe the germination of seed and growth of the plants.

(9) The Effect of Depth of Planting on the Germination of Seeds.

Using a large Mason jar, or preferably, a box five or six inches wide and twelve to fifteen inches long. Fill the vessel with good loam soil and plant seeds. Plant from one inch to six inches respectively, beneath the surface. The boxes should be at least eight inches deep and the seed placed next to the glass so that the sprouting and growth may be observed.

(10) To Show that Air is Necessary for the Germination of Seed.

A tightly stoppered bottle, freshly boiled water, and seeds of corn or wheat are required for this exercise. Place a small quantity of the seeds in the bottle and fill completely with the boiled water after it has been cooled. Stopper the bottle tightly and note results. The same results may be observed also, in connection with Exercise (8).

(11) To Compare the Fertility of Soils and Subsoils.

Secure small quantities of good surface soil and of yellow compact subsoil if available. Fill one or two ordinary six or eight inch flower pots with each kind of soil. Plant seeds and note the effect on growth.

(12) To Become Familiar with the Characteristic Properties of Common Fertilizing Materials.

Nitrogenous materials.

Have small quantities of nitrate of soda, sulphate of ammonia, dried blood and concentrated tankage.

Pupils should become familiar with the usual color of these substances by frequent examination and observation. In the case of the nitrate and ammonium salts, they should learn to recognize them by taste; placing a small bit on the tongue. The relative solubility of the materials should be studied by placing a small quantity of each substance in a test tube or a small bottle and adding water. Other substances besides those mentioned may be utilized, for example, ground leather, tobacco stems, cotton seed meal, etc. Note the relative solubilities of the various substances.

(13) A Continuation of Exercise (12).

(14) Potash Materials.

Use small quantities of muriate of potash, sulphate of potash, kainit, and any other available materials which may serve as a source of potash for plants. Observe their relative solubilities, color, taste, etc., as directed in Exercise (12).

(15) A Continuation of Exercise (14).

(16) Phosphatic Materials.

Using acid phosphate, rock phosphate, steamed bone meal, raw bone meal, and basic slag. Study their characteristic properties as directed for Exercise (12), and in addition determine the relative per cent of rock phosphate which will pass through a screen having eighty to one hundred meshes to the inch. The finer rock phosphate is ground, the more readily will it become available to plants.

(17) A Continuation of Exercise (16).

(18) To Become Familiar with the Appearance, Properties and Commerical Names of the Various Forms of Agricultural Lime.

Have on hand a small quantity of quicklime (calcium oxide), slack lime (calcium hydrates) and ground limestone (calcium carbonate). Apply a few drops of dilute hydrochloric acid to each of the above named materials. Note what happens. To a small lump of quicklime, the size of an egg, add water slowly until the lump crumbles or falls apart. Explain this process of water slacking. Using a known weight of ground limestone, determine the relative propor-

tion of the various sized particles by sifting through a series of sieves having, forty, sixty, eighty, and one hundred meshes to the inch respectively. At least fifty per cent (50%) of ground limestone intended for agricultural use should pass through an eighty mesh sieve.

(19) To Test Soils for Acidity.

Place a piece of blue litmus paper in the bottom of a tumbler. Cover the litmus with one or two thicknesses of filter paper or one of white blotting paper. On top of the filter paper put about an inch of soil to be tested and saturate with distilled water. Similarly prepare a second tumbler as a check, leaving out the soil. Set both tumblers aside for twenty or thirty minutes and examine the litmus paper through the bottom of the glass. If the litmus paper in the glass containing the soil has become perceptibly reddened, add ten to fifteen drops of lime water and again examine the litmus for any change of color.

Second Method.

Place a heaping tablespoonful or two of soil in a small dish, add enough distilled water to make the soil plastic. Insert a piece of blue litmus paper into the soil, pressing the soil down firmly upon it. Set aside for thirty or forty minutes, and examine the litmus for any change of color. Red indicates acidity, blue, or no change indicates alkalinity or neutrality.

(20) To Show the Effect on Soils by Working Them when Too Wet.

Place a large tablespoonful of clay soil in each of two small dishes. Add water to one of them slowly until just enough is added to moisten it nicely. To the other add water until the soil becomes plastic or sticky. Allow to stand for ten to fifteen minutes. Then with a stick or with the fingers stir up both samples thoroughly. Set in the sun or an oven to dry, and when dry note the difference in character between the moderately wet soil and the sample which was moistened in excess.

(21) Calculating the Amount of Plant Food Removed from the Soil by Average Yields of the Common Farm Crops.

Ascertain the average per cent of nitrogen, phosphoric acid, potash and lime contained in the grain, straw and stover of the more common farm crops, such as wheat, oats, corn,

rye, etc., and also, in clover, alfalfa, timothy, soy beans, or any crop which may be of special interest in the community. Using the average yields per acre for these crops, calculate the amount of plant food removed from the soil by any crop or rotation of crops.

(22) Continuation of Number (21).

(23) To Show the Saving of Plant Food by Feeding the Crops Grown on the Farm, and Returning the Manure to the Land, as Compared to Selling the Crop Directly.

Assume that a corn crop yields fifty bushels of grain and fifteen hundred pounds of stover, containing twenty-four pounds of nitrogen, nine pounds of phosphoric acid, and five and one-half pounds of potash in the grain; and fifteen pounds of nitrogen, four and one-half pounds of phosphoric acid and twenty-one pounds of potash in the stover. There would thus be a total of seventy-nine pounds of actual plant food taken from the soil. Unless this is returned in some other form, the soil is poorer to the extent of seventy-nine pounds of plant food than it was before, in case the crop is sold directly. On the other hand if all the crop is fed on the farm and the manure produced is carefully saved and returned to the land, approximately eighty per cent. of the plant food contained in the ration would be saved, and instead of losing seventy-nine pounds, there would be a loss of only 15.8 pounds and the remaining 63.2 pounds would go back to the soil in the manure.

This calculation may be simplified by merely calculating the amount of nitrogen alone in both the grain and straw or by calculating all three of the elements, nitrogen, phosphoric acid, and potash in the grain alone, or in the straw alone and still give the pupils a good practical idea of this sort of calculation.

(24 Continuation of Number (23).

(25) To Study the Capillary Rise of Water in Natural Soils of Different Texture.

Use ordinary straight lamp chimneys, or glass tubing, two inches in diameter and twelve inches long. Tie a piece of muslin over one end of each tube and fill with the soils to be used. Place the tube in a pan containing water to the depth of about one inch. Observe and explain results. A sandy, a clay and a loam soil will give very good results.

(26) Capillary Rise of Water as Affected by Plowing Down Large Quantities of Undecayed Organic Matter.

Use glass tubes or chimneys. Prepare in the same way as indicated in Exercise (25). Insert into each tube three to five inches of sandy soil if available. On top of this put about one inch of chaff or finely cut straw and complete the filling of the tube with loam soil. Place in a pan of water as indicated in Exercise (25). Observe the results.

Additional interest may be derived from this exercise by having one tube containing sand in the bottom and loam on the top, without the intermediate layer of chaff.

(27) Capillary Rise of Water as Affected by Plowing Under an Unpulverized or Cloddy Surface.

This exercise may be carried out in exactly the same way as Number (26), except that cloddy soil is used in place of chaff or other forms of organic matter.

(28) Weight of Soils Per Cubic Foot.

Use any sort of available container (not too large) the cubic content of which is known. Fill with soils of different kinds; ascertain the weight of the known volume and calculate the weight per cubic foot. For this purpose the soils should be thoroughly aired dry and the computation made on the basis of the dry weight of soil.

(29) Percolation Experiment of Natural Soils of Different Texture.

Use lamp chimneys, two inch glass tubing, or beer bottles with the bottoms cut off. Tie a piece of muslin or cheesecloth over the mouth of the bottle or one end of the tube, or chimney, and fill with different kinds of soil to within a couple of inches of the top. Add water to the surface and note the rate of percolation through the different types of soil. After filling with soil, the bottle or tube should be jarred lightly to settle the soil in each. It is well to note the amount of water added to each kind of soil and the amount which drips through in a given time, say two periods of twenty to thirty minutes each.

(30) Physical Effect of Lime on Clay Soils.

Use three portions of 150 grams each of clay soil. Add to one about two per cent of lime (calcium oxide), and to another about five per cent., and leave the third without anything. Add water in excess to all three samples and

stir each one to a good, stiff mud. Mould into small cakes with the hands and dry in the sun or in an oven. When they are thoroughly dry, crumble with the hands and note differences in the ease with which they may be pulverized.

(31) How to Conduct a Fertilizer Plot Test.

If sufficient land is available, this exercise may be carried out under actual field conditions. Where this is possible, plots of one square rod in size or larger should be layed off accurately. Care should be taken to have the plots on soil which are as uniform as possible, and fertilizers applied to the plots as follows:

Plot No. 1. Nothing.
Plot No. 2. Nitrate of soda at the rate of 160 lbs. per acre.
Plot No. 3. Acid phosphate 320 lbs. per acre.
Plot No. 4. Muriate of potash 80 lbs. per acre.
Plot No. 5. Nitrate of soda 160 lbs., acid phosphate 320 lbs. per acre.
Plot No. 6. Nitrate of soda 160 lbs., muriate of potash 80 lbs. per acre.
Plot No. 7. Nothing.
Plot No. 8. Muriate of potash 80 lbs., acid phosphate 320 lbs. per acre.
Plot No. 9. Nitrate of soda 160 lbs., acid phosphate 320 lbs. per acre.
Plot No. 10. Barn yard manure 12 tons.
Plot No. 11. Nothing.

This plan may be expanded or contracted to conform with given conditions in different localities.

Where sufficient ground is not available or the proper fertilizing materials may not be conveniently secured the pupil may be given practice in planning such test by drawing a series of plots on paper, making drawings to scale, and then computing the amount of each of the fertilizing materials which would be necessary to apply to a plot of any given size in order to secure the same rate of application per acre as above indicated.

(32) Calculation of Fertilizer Formulas.

In calculating formulas for home mixed fertilizers it is necessary to know the percentage composition of the fertilizing materials which it is desired to use. The following example will serve to illustrate the method of calculation.

Assuming that it is desired to compute a fertilizer formula having two per cent. of nitrogen, ten per cent. of phosphoric acid and four per cent. of potash. We would first ascertain the number of pounds of each of these ingredients that a ton of such fertilizer would contain. This would be forty pounds of nitrogen, two hundred pounds of phosphoric acid and eighty pounds of potash. Assuming again that we are going to use as sources of these materials, nitrate of soda containing fifteen per cent of nitrogen, acid phosphate containing fourteen per cent. of available phosphoric acid and muriate of potash equivalent to fifty per cent. of actual potash. With these materials available, how much of each must be used to make a fertilizer having the desired composition? This is ascertained by dividing the pounds of each ingredient that would be contained in the ton of fertilizer by the percentage composition expressed decimally as follows:

$40 \div .15 = 266$ pounds of nitrate of soda.

$200 \div .14 = 1{,}430$ pounds of acid phosphate.

$80 \div .50 = 160$ pounds of muriate of potash.

This gives a total of 1,856 pounds, which is 144 pounds less than a ton. So to make out the 2,000 pounds we may add 144 pounds of clean sand or dried screened soil or any such material to make weight. This will then give us a ton of fertilizer containing forty pounds of nitrogen, 200 pounds of phosphoric acid and eighty pounds of potash which in per cent would be 2-10-4 respectively.

In making these calculations decimals have been disregarded, but the computation is sufficiently accurate for all practical purposes.

(33) Continuation of Number (32).

Make various compositions and from various ingredients.

(34) Practice in Home Mixing.

Where facilities are available and the actual fertilizing materials can be secured, it is highly desirable to give the pupils some actual practice in mixing the materials in proper proportions for fertilizers of various compositions. The practice being based on the formulas calculated in Exercises (32) and (33). The conditions necessary for this practical mixing are a tight floor, a pair of platform scales the necessary fertilizing materials, a sand screen, and a hoe or a shovel with which to do the mixing.

(35) Determination of Moisture in Field Soils.

Secure samples of soil from the field, weigh the samples, dry thoroughly, weigh again and determine the per cent. of moisture, based on the dry weight of soil, the working condition of the soil should be carefully noted at the time the samples is taken. The samples should also be placed in a tight jar, such as a Mason jar and quickly covered to prevent loss of moisture by evaporation.

(36) To Show the Shrinkage of Clay Soils on Drying as Compared with Sandy Soils.

For this exercise shallow tin boxes three inches or more in diameter may be used. Wet the soils until they are in a plastic condition. Fill the pans, pressing the soil down firmly and dry thoroughly, preferably in an oven. When the soils are thoroughly dry, measure the diameter of the pan and of the soil mass. The difference is due to shrinkage. This should be calculated in per cent. and attention called to the tendency of clay soils to crack when dried in the field.

(37) To Show that Organic Matter is an Aid in Reducing the Tenacity of Clay Soils.

Follow the instructions given in Exercise (30) except that instead of adding lime add fifteen per cent. of organic matter; otherwise proceed as outlined in Exercise (30).

(38) Effect of Mulches on the Evaporation of Water.

Punch five or six holes in the bottom of several empty tomato cans with a nail. Fill each can with fine loam soil from the field. Saturate the soil with water and allow it to drain until the soil is in a workable condition. Weigh the cans. With a sharp stick stir the soil in one can to a depth of three-fourths of an inch. Stir the surface of the second can to the depth of an inch and a half. Leave a third can without any surface treatment. Expose all cans to the same conditions of sunlight and air currents. Weigh every other day for a week or more, and note carefully the losses in weight from the different cans. This is due to the evaporation of moisture.

(39) Effect of Different Kinds of Mulches.

Proceed as in Exercise (38), and when the soils are dry enough to cultivate, remove an inch of soil from the surfaces in all the cans but one. Replace this inch of soil as follows:

In one can use dry sand or dry sandy soil. In a second use a fine, dry clay, in a third use very finely cut straw, or chaff. Proceed and note results as directed in Exercise (38).

Additional cans and other mulching materials may be used according to the needs and facilities available. If larger cans are available, the experiment will be more accurate. This is also true in Exercise (38).

(40) To Observe the Effect of Having a Loose Soil Surface on the Absorption of Rain Water.

Use a half dozen straight lamp chimneys, or two inch glass tubes, ten or twelve inches in length. Tie a muslin dam over an end of each tube. Fill two tubes with clay, two with loam and two with sand. With a wooden stick compact the sand in one tube, the clay in one tube, and the loam in one tube. Leave the soil in the other tubes unpacked. Add exactly the same amount of water to each tube and note the time necessary for the water to disappear beneath the surface.

Call attention to the practical application of this exercise to field practice. It shows the ability of a loose surface to absorb rainfall as compare with the same ability where the soil is close and compact.

Farm Crops.

(18 Weeks.)

TOPICS FOR STUDY.

1. *Seeds and Crops.*
   - A. Importance of Good Seed.—Discuss purity of seeds; vitality as affected by age, weather, time of harvesting, plant diseases, etc. Difficulty of getting good seed of grasses and other small seeded plants.
   - B. Classification of Crops.—Define terms: Grain crops, forage crops, cover crops, catch crops, small grains, cereals, legumes. Forage crops may be used in the form of silage, soiling, hay, pasture.
   - C. Classification (continued).—Explain tubers, roots, bulbs; miscellaneous crops, like pumpkins, cabbage, hops, tobacco. Illustrate and note botanical relationships.

D. Principles of Planting Seeds.—Proper seed bed as to pulverization, moisture, warmth. Depth of planting governed by size of seed, condition of soil, time of the season. Rate of seeding affected by condition of soil, time of sowing, method of distributing, purpose of crop.

2. *Grain Crops.*

A. Corn.—Origin. Geographical range. Kinds of corn and description, viz: Dent, flint, pop, sweet, soft and pod. Varieties due to climate, color, composition.

B. Corn.—Soils. Preparation of seed bed: (a) Fall and spring plowing. (b) Fitting. (c) Manuring and fertilizing—time, manner and amount.

C. Corn.—Planting. Time. Manner: Hills or drills. Use of furrow opener; listing; surface planting. Rate. Depth to cover.

D. Corn.—Cultivation. Object. How often. How long. Harvesting—5 ways, viz.—shocking, soiling, siloing, hogging, husking from stalk. Shrinkage in crib.

3. *Grain Crops* (Continued).

A. Corn.—Silage. When to cut. How to put in silo. Outfit and machinery necessary. Amount per day. Changes taking place in silo.

B. How to Make a Silo.—Merits of the different kinds. Care of silo. Capacity of silos.

C. Corn.—Seed selected. Time and manner. Character of stalk from which to select. Storing seed. Testing: Time and methods.

D. Corn.—Grading after testing. Regulating the planter. Varieties.

4. *Grain Crops* (Continued).

A. Wheat.—Origin. Geographical range. Wheat types (botanical). (Illustrated by specimens grown in school garden.)

B. Wheat.—Varieties in grade of wheat in United States caused by climate conditions. Wheat soils.

C. Wheat.—Seed bed preparation: Breaking, discing, etc. Value of early breaking. Corn ground vs. oat or other stubble ground.

D. Wheat.—Manures and fertilizers for wheat. Kind, time to apply.

5. *Grain Crops* (Continued).
   A. Wheat.—Time to sow. Danger from Hessian fly. Method of sowing. Rate to sow. Depth of covering. Quality of seed. How to prevent smut and scab. Insects.
   B. Wheat.—Varieties. Harvesting: When, how. Threshing. Sweating of wheat. Principles of flour-making.
   C. Oats.—Origin. Geographical distribution. Climate adaptation and influences. Winter oats. Spring oats.
   D. Oats.—Soils. Seed-bed preparation. Preparation of corn stubble by discing. Advantage of plowing. Fertilization for oats.

6. *Grain Crops* (Continued).
   A. Oats.—Time to sow. Methods of distributing the seed. Rate of sowing. Depth to cover seed. Harvesting and threshing similar to wheat. Varieties.
   B. Rye.—Origin. Soil adaptation. Seed-bed preparation; sowing, harvesting, threshing (same as for wheat). Use of grain; of straw.
   C. Barley.—Same as oats.
   D. Market Grades of Grain.—Necessity for inspection of grain. Influence of moisture content in case of corn. Sulphured oats. Weight of wheat. Explanation of the various grades.

      Work up this lesson from information gained from grain dealers, also, Bureau of Plant Industry, Bulletin No. 99 and Circulars Nos. 32, 74. Get copy of rules through county superintendent from Chicago Board of Trade.

7. *Grain Crops* (Continued).
   A. Soy Beans.—Origin. Geographical distribution. Soil adaptation, good corn land. Seed-bed preparation, same as for corn. Fertilization, minerals only. Being a legume it supplies its own nitrogen.
   B. Soy Beans.—Inoculation with soil or pure culture. Time to plant. Distribution of seed and methods of planting; drills or broadcast, using corn planter or grain drill. Should be covered two inches deep.
   C. Soy Beans.—Rate of planting, according to the method. Planting as a catch crop in corn or after some other crops. Cultivation similar to corn. Harvesting: Time (a) for seed, (b) for hay, (c) as pasture. How to cut.

D. Soy Beans.—Threshing; regulating machine. Uses of soy beans: Hay, pasture, grain, production of oil, soil improvement. Varieties: Considerable attention should be given to varieties.

8. *Grain and Forage Crops.*

A. and B. Cowpeas.—Similar in almost every respect to soy beans, and should be covered in two lessons.

Forage Crops: Soy beans are usually classed as forage crops, but because of the large use made of the grain, they have been included under grain crops.

C. and D. Clover.—Definition of the true clovers. Kinds and description of each. Soils and climatic adaptations. Peculiar adaptation of each.

9. *Grain and Forage Crops* (Continued).

A. Continuation of C. and D. under Topic 8.

B. Clover.—Time and rate of sowing. Methods: Sowing with wheat or oats, alone, in corn, etc.

C. Clover.—Harvesting for hay; for seed. Principles of curing hay. Cause of clover failures in Indiana. Danger of bloating when pasturing. Any legume will cause bloating.

D. Alfalfa.—Origin and distribution. Soil adaptations. Conditions of soil favorable to success. Physical preparation of the seed bed.

10. *Forage Crops.*

A. Alfalfa.—Liming for alfalfa. Kinds: When and how to apply. Inoculation: Why, when and how.

B. Alfalfa.—Sowing: Time and rate. Spring, summer, autumn, with and without a nurse crop. Clipping first year.

C. Alfalfa.—Making hay: When ready to cut. Curing, not specially different from clover. Be sure to save the leaves. Number of cutting per season. Relative value of such yield.

D. Alfalfa.—After treatment—harrowing or discing after cutting. Fertilization—use of minerals only—manure too weedy. What to do when growth turns yellow.

11. *Forage Crops* (Continued).

A. Alfalfa.—Varieties. Source of seed. Uses: Hay, pasture, soiling, silage, ground for various commercial stock foods.

B. Sweet Clover.—Origin and distribution. Botanical relationships and characteristics. Probability of its becoming useful. Time, method and rate of seeding. Uses: Hay, pasture, soil improvement.

C. Canadian Field Peas.—Botanical relationships. Soil and climatic adaptations. Time, method and rate of sowing. Uses: Soiling and hay. Usually sown with oats.

D. Vetch.—Botanical relationships. Kinds. Hairy vetch the only one useful in Indiana. Soil adaptation. Seed bed preparation. Time, method, and rate of sowing.

12. *Forage Crops* (Continued).

A. Vetch.—Uses: Soil improvement, soiling, pasture, hay. Best sown with rye or wheat. Time to cut. Danger of reseeding and appearing as a weed in wheat.

B. Grasses.—Distinguish from clover. Explain characteristics requisite for a good hay grass; for a good pasture grass. Seeds, usually chaffy and low in vitality.

C. Timothy.—Soil and climatic adaptation. Time, method and rate of seeding. Harvesting for hay and seed. Why a popular grass?

D. Orchard Grass.—Same as timothy.

13. *Forage Crops* (Continued).

A. Red Top.—Same as timothy.

B. Kentucky Blue-grass.—Same as above, except used almost entirely as a pasture grass.

C. Canadian Blue-grass and English Blue-grass.—Special adaptation. Note botanical distinctions.

D. Brown Grass, the Rye Grasses.—Same as C.

14. *Forage Crops* (Continued).

A. Making a Pasture.—Mixture preferable to single species. Sow large quantities of seed. Give time for sod to farm. Fertilization of pastures. Occasional harrowings or discings good.

B. Treatment of Meadows and Pastures.—Similar to pastures. Usually last only two or three years. Fertilization should furnish nitrogen. Liming may be beneficial, especially for Kentucky blue-grass and timothy.

C. Sorghum.—Culture similar to corn. Amount of seed per acre. Time to sow; time to cut. Uses: Mainly for soiling.

D. Rape.—Description of plant. Soils: Good corn land. Preparation of seed bed. Time, method, and rate of sowing. When ready to use, mostly used for pasture. Injurious effects: sore ears, bloating, tainting milk.

15. *Forage Crops* (Continued).

A. Millet.—A term applied to several species of plants. Used as human food in the Old World, forage in America. Groups: Foxtail, barnyard, broom corn, cat-tail. Foxtail group: Adaptation, seed bed preparation, time, method and rate of sowing. Harvest before seed forms. Varieties.

B. Millet.—Barnyard, broom-corn, and cat-tail groups. Same outline as for foxtail group. Uses of millets, hay very little, value for pasture or green feed. Why?

C. Combination Crops.—Rye and hairy vetch, or wheat and hairy vetch. Canadian field peas and oats. Oats, rape and clover. Corn and soy beans, or corn and cowpeas. Millet, sorghum and cowpeas or soy beans. Millet and soy beans or cowpeas. Barley and Canadian field peas. Time, method and rate and usage of each.

D. Cover Crops.—Crops sown to cover the ground during winter, preferably something that will remain green. Rye, or rye and vetch. Crimson clover. Red or mammoth clover. Cowpeas or soy beans. Oats. Time and rate of sowing.

16. *Potatoes.*

A. Succession of crops either for complete or partial soiling.

B. To supply green feed for summer pasture.

C. To supply green feed for cattle, sheep and hogs.

D. Potatoes.—Botanical relationships. Origin. Importance as a food crop. Soil adaptation. Seed-bed preparation. Fertilization. Time to plant for early use; for late use.

17. *Potatoes, Root Crops, Sugar Beets, Flax.*

A. Potatoes.—Rate and method of planting. Planting under straw. Cultivation. Spraying. Harvesting. Storing. Varieties—give special attention.

B. Root Crops.—General conditions—rich, deep soil. Seed bed preparation, thinning cultivation. Roots grown: Carrots, parsnips, turnips, mangel wurtzels (mangels). Time, method, and rate of sowing each; harvesting and storing. Uses; yields.

C. Sugar Beets.—Grown both for food and for sugar production. Requirements of soil and climate. Seed bed preparation, sowing, cultivation, etc. Harvesting, yields. Sugar manufacture.

D. Flax.—A fiber and seed crop. Climatic and soil conditions. States raising flax. Not grown in Indiana to any extent because other crops more profitable. Time, method, and rate of sowing. Harvesting, retting, yields.

18. *Hemp, Cotton, Rice, Sugar Cane.*

A. Hemp.—States growing it. Soil adaptation. Time, method and rate of sowing. Harvesting, retting, breaking, yields.

B. Cotton.—Strictly a Southern crop. Importance of crop. Soil. Seed-bed preparation. Time, method, and rate of planting. Cultivation, harvesting, insects.

C. Rice.—A grain crop. Section of the United States to which adapted. Soil requirements. Preparation of seed-bed. Time, method, and rate of sowing: (a) on small areas; (b) on large areas. Flooding, harvesting, threshing, polishing.

D. Sugar Cane.—A tropical crop. Parts of the United States to which adapted. Seed-bed preparation. Method of planting. Irrigation in certain sections. Harvesting. Crops obtained. Sugar manufacture.

Demonstration Exercises in Crops for High Schools.

The accompanying exercises are not specially arranged in any logical order, except the grain scoring. Conditions will differ in each community and the instructor must be the judge of the appropriate time to present each exercise. While sixty-three exercises have been planned, it is doubtful if they can be covered with any degree of completeness in that number of periods.

(1) Determining Stand of Corn in the Field—

Definite areas should be studied. Each student should count the stalks as they stand in row. A full stand should be regarded as two stalks per hill or, in case of drill corn,

one stalk every fifteen inches. Three different areas should be counted by each student and the average taken.

(2) Finding Average Leafage and Calculating Leaf Areas—

Count the number of leaves on fifty (50) different stalks as they run, and take the average. Estimate the leaf areas of an average leaf. On the basis of the stand already determined, calculate the leaf area per acre. Suppose that each fully grown stalk were to evaporate from its leaf surface, two pounds of water each day, from July 20th to August 20th, what number of inches of rainfall would be represented?

(3) Finding the Average Height of Stalks—

With a graduated staff, measure and record height of two hundred (200) stalks as they run in the field. Three representative areas should be measured, and the average of the three taken. Note also, extremes of height.

(4) Determine Per Cent. of Barren and Nubbiny Stalks—

Taking five hundred (500) stalks as they run in the field, count the stalks which are destitute of ears, and also those which have ears less than four inches in length. Estimate the per cent. of barren stalks, also the per cent. of stalks with nubbins. The remainder bear merchantable ears.

(5) Estimate Yield Per Acre—

On the basis of the data obtained in the last exercise calculate the yield per acre, supposing that each stalk has a merchantable ear which weighs twelve ounces (12 oz.). Suppose that every stalk in the field bears a twelve-ounce ear, on the basis of the stand what would be the yield per acre? Estimate the yields for sixteen ounce (16 oz.) ears. Also for the full stand.

(6) Selecting Ears for Seed in Field—

Students should study stalks and ears as they stand in the field. Select ears from stalks of medium height, strong at the base, and tapering gradually at the top. The ears should be borne about three and half or four feet from the ground, have short shanks, and be inclined downward at the tip. Stalks from which ears are selected should not have special advantage of space in the row or hill. Good size and well shaped ears should be selected. Maturity as indicated by the husks should be studied. Each student should select or mark at least one hundred (100) ears.

(7) Methods of Storage—

Class should place ten or more ears under various conditions for winter storage. A lot should be stored in a warm, dry basement. Another lot in a well ventilated room where there is no heat. Still another lot should be hung over a pole in an open shed, or hung to rafters in a barn or shed. Another lot should be hung in the open, with the husks left intact. These lots of corn are to be tested for germination in February or March.

(8) Seed Corn Testing—

The lots of corn stored in the fall should be tested for germination the latter part of February or March, using not less than five kernels from each ear. Corn should be obtained from home or other farmers and tested.

(9) Grading Seed and Calibrating Planter—

The ears selected for seed should have butts and tips removed. Why? Ears should then be shelled so as to put kernels of the same size and shape together. If a mechanical grader is at hand, this should also be used and the results compared with hand selection. Tests should be made to find the size of planter plate which will drop the right number of grains of the different sizes, also planter should be regulated to drop the right distance apart when drilling. Seed containing both butts and tips should also be used in testing, and the results compared with graded seed.

(10) Corn Scoring-Shape of Ears—

Class should measure the length and the circumference of a large number of ears, say twenty-five (25). Number the ears and tabulate the measurements. Measure the circumference in two places, one about two inches from the butt, and the other about three inches from the tip. The proportion of length to circumference should be tabulated for each measurement. Do not use fractions smaller than eighths.

(11) Corn Scoring—Various Items—

Using the same twenty-five ears, count the rows per ear and tabulate the results, also determine the number of kernels per inch in row and tabulate. Look for crossed grains and cobs off color. Take a hundred kernels from as many different ears and determine the percentage that meet the standard proportion, that is, twice as long as wide. Study the germinating quality of fifty (50) different ears by dissecting out the growing part of the germ.

(12) Corn Scoring—Proportion of Grain—

Study the proportion of grain to total weight by weighing and shelling a number of ears, at least ten. Before weighing and shelling the student should guess what percentage of the total weight will be grain. If measurements of ear and grain are made and all data tabulated, the exercise will be more valuable.

(13) Corn Scoring—Applying the Score Card—

The regular corn grower's association score card should be used, and each student have at least five ears which are distinguished from each other by labels. A mathematical value should be given to each ear for each point on the score card, except Uniformity of Exhibit. This value should be entered in the square opposite the point considered and in the column corresponding to the number of ear. For example, say the score is six for "shape" of ear number one, the figure six should be entered in the square opposite the item Shape of Ear and in column one. Enter the score for each of the five ears on Shape of Ear before passing to the next point, Length of Ears. Proceed in this way with each of the various points in the score card, keeping in mind all the time that there are few perfect ears and that the value of the different points is not the same. The student should score a considerable number of samples. After using two or three five-ear samples, increase the size of samples to ten ears.

(14) Same as (12), Using Different Samples.

(15) Same as Above, Using Different Samples.

(16) Corn Scoring—Ten-Ear Lots—

In the previous exercises the scoring has been on the basis of individual ears. The student should now learn to size up an exhibit of ten ears as a whole, expressing the value of the entire ten ears with one number for each of the points of the score card, beginning with Uniformity of Exhibit. Previous practice should enable a student to see at a glance the defects of the various ears and to be able to determine the composite value quickly. A considerable number of samples should be worked with in this manner.

(17) Same as (16).

(18) Corn Scoring—Comparative Judging—

A number of samples of ten or more ears should be provided for the use of the pupils. These should consist, as far

as possible, of different varieties and different colors. All ears should be labeled and the lots numbered. In most cases, one period for each item of the score card should be given to the placing of the ears in their relative order of merit. For example, under Shape of Ear, the best ear so far as the shape is concerned, all other points ignored, should be placed first and then follow with the second best ear, so on until all the ears of the lot are placed in their order. Follow this procedure for each of the points of the score card. The instructor should previously place the ears according to his judgment.

(19) to (26) Same procedure as in (18).

(27) and (28) Scoring Wheat and Oats—

Using the Indiana Corn Growers' Association score card for wheat and oats, score several samples of these grains. The explanation on the score card should not be followed too literally except in case of Weight. The rule here should be applied strictly.

(29) Preparing Seed Grain by Use of the Fanning-Mill—

Have students clean and grade several samples of wheat and oats. Students should understand the use of the different screens and should have practice in adjusting the mill for the different grains.

(30) Treating Seed Wheat for Stinking Smut—

Before giving this exercise, the teacher should have Circular No. 22 from Purdue University. Pupils should bring a bushel or two of wheat to the school. The cement floor of a basement or porch can be used for spreading out the grain.

(31) Examining for Hessian Fly—

This exercise should be performed either in November or late in April. It will be necessary to take pupils to the field to make examinations. Individual plants should be dug up and carefully examined by stripping down the leaves. If the insect is present the larval, or chrysalis form, will be found near the base of the leaf sheath. The teacher should have carefully read Newspaper Bulletin No. 194 Purdue University, or Circular No. 23, the same place.

(32) Studying Stooling Habits of Wheat—

This exercise should be performed in November or April. Individual plants should be dug up and the number of plants which have started from the original shoot counted. If the

digging is carefully done, the grain of wheat from which the plants started can be found. The more stools or tillers which have started from one seed the better is the prospect for a large yield. See if there is any difference in stooling between places where the plants are thick and places where they are thin on the ground. A couple of plats in the school garden will be very advantageous for this study.

(33) Estimating the Per Cent. of Winter-Killing and Studying Protective Conditions—

This study may be made either in the field or in garden plats. A large area is preferable. For the most part the per cent. of winter-killing is usually estimated by taking an area on which the stand is practically perfect, and compare other areas with it. There should be an average of one plant for each inch in the drill row for a perfect stand.

The study should be made of the various areas where winter-killing is most apparent, and see if a reason for such condition can be found. Poor soil, depression in land where water stands, and extreme exposure are some of the causes of winter-killing.

(34) Determining the Stand in the Field and Height of Plants—

It may be necessary to use this exercise as a home study project. The pupils should note whether the stand at maturity is different from the stand in April. By means of a graduated staff the height of one hundred (100) plants should be obtained and average height should be determined and note made of the estimates.

(35) Per Cent. of Smutted and Scabbed Heads in Wheat—

This also should be a home project. At about the time wheat has come into full head, there frequently appears a number of heads, black in appearance. These have been attacked by loose smut and ruined. After a few days the smutty parts blow away and the naked stems remain. Take a barrel hoop and fasten three legs to it. Set this down at random in the field. Count all the stems enclosed and find what per cent. smutted stems are of the total. Repeat this for several areas.

Scabbed heads are white in appearance and appear to be mature several days before the general crop; an examination will show that the grains are shiveled and are covered with a pinkish mold. This is the wheat scab, a fungous disease.

Determine the per cent. of scabby heads in the same way as the smutted heads were determined.

(36) A Study of Mature Heads of Wheat—

The heads of wheat used should belong to the same variety. However, more than one variety may be studied. Measure not less than twenty-five heads and tabulate the lengths. Notice the arrangement of the spikelets—alternating on each side of the single stem (rachis). Note how the grains are enveloped by the chaff. If the variety is bearded, observe which chaff bears the beards. Carefully shell out the grains from each spikelet and lay them in order so that the product of each spikelet can be seen. Study the grain as to size, length, color and hardness. Observe the small tuft of hairs at the end of the grain. Make a drawing of the grain showing the germ, the crease and the tufts of hairs.

(37) A Study of Mature Heads of Oats—

Try to have both open-panicle and close-panicle (side) varieties; note the number of grains per spikelet. Determine the average number of grains in five heads (panicles), note the difference in size of the grains in the spikelets. Determine the per cent. of hull in oats, this is done by weighing one or two grams and then stripping the hulls from the kernels and reweighing; this will require a balance which will weigh accurately tenths of a gram. More than one variety should be studied.

(38) A Study of Mature Heads of Rye and Barley—

Try to have both two-rowed and six-rowed varieties of barley. Study carefully the arrangement of spikelets in the rye and barley and compare with wheat. Observe that there are three spikelets at each joint of the rachis in the case of barley and but one in the case of wheat and rye. The barley spikelet is definitely one-grained, the rye two-grained, while the wheat spikelet has two or more grains. Make drawing illustrating these differences.

(39) Comparison of the Grain of Wheat, Oats, Rye, and Barley—

Select five or ten grains of each kind, study these grains with reference to size, shape, weight, and color. Note that the grains of oats and barley are composed of two parts, namely, the hull and the kernel proper. Make drawings of the different grains, and record carefully the data relating to the other points.

(40) Preparing Seed Oats, Estimating the Stand and Determining the Per Cent. of Smutted Heads in Oats—

Follow the directions given under exercises (30), (33), and (35).

(41) Field Study of the Leaves of Different Clovers—

This exercise should be prepared for by sowing some months before in small plats as many different kinds of clovers as can be had. Students should make drawings of the leaves of the different clovers, noting carefully the shape of the leaflets, the serrations of the margins, and the attachment of the terminal leaflet. Besides the drawings there should be written descriptions.

(42) The Leaves and Inflorescences of Different Grasses—

This must also be previously prepared for. At least Kentucky blue grass, timothy, red top, orchard grass, and tall oat grass should be studied. Make drawings and measurements of the leaves and inflorescences (panicles). Determine the average number of leaves on ten stems of each species. Determine the average height of plants. Also, the proportion of inflorescences to total height.

(43) Estimating the Clover Seed Crop—

Gather ten representative ripe heads of clover. Carefully shell out each head and count the seeds. Determine the average number of heads on several different areas as indicated in exercise (35). On this basis how many heads per acre? What number of seeds per acre? Counting eighteen million seeds per bushel, how many bushels per acre? If convenient, weigh the seeds and count (450) grams per pound, and thus determine the yield.

(44) and (45) Collecting Weed Seeds—

Each pupil should collect the seeds of at least twenty-five (25) different weeds common in the community.

Small two-dram bottles properly labeled are best for holding seeds. Make measurements, descriptions, and drawings of representative seeds of each species.

(46) A Study of Clover Seeds—

Collect, label, measure, describe and draw representative seeds of all the different clovers obtainable. Include in this collection sweet clover, alfalfa, and, if obtainable, bur clover.

(47) Germination and Purity Tests of Clover Seed—

Take such samples of clover or alfalfa seed as are obtainable in the neighborhood or from the warehouse and determine what species of weed seeds are present. If they cannot all be named, at least determine how many kinds of foreign seeds are present. Weigh out a definite quantity, say one gram, and determine the percentage of weed seed by count. Count out two lots of (100) seeds each and germinate. Multiply the per cent. of purity by the per cent. of germination. The result is the per cent. of pure and germinable seed. See Farmers' Bulletin Number 260.

(48) Inoculating Legumes—

Write to some of the firms advertising inoculating material for sample lots. Prepare small areas of ground and treat according to directions sent with the sample packages. On some similar areas use soil inoculation as described in Purdue Extension Leaflet Number 44. Small areas should be left untreated for checks. Before the plants are mature they should be carefully dug up and the roots examined for nodules.

(49) Field Study of Cowpeas and Soy Beans—

Examine fully developed plants and note characteristics with regard to the following points: character of growth, whether erect or trailing; hairiness of the plant; color of blossoms; length of pods; average number of seeds per pod; and character of foliage. Make such drawings as will show differences.

(50) Weed Eradication—

Plants which propagate themselves by means of seeds only may be eradicated by preventing their seeding. Plants which propagate by means of underground rootstocks must be starved out by preventing the growth of above ground parts. Of the first group such plants as ragweed, foxtail, smartweed, and butterprint are examples. In the second class we have Canada thistle, horse-nettle, quackgrass, trumpet vine, wild onion, etc.

Some or all of the above named plants should be studied in the open field in order that the student may fully understand the method of propagation. He should see how the underground parts give rise to new plants; he should under-

stand how cultivation tends to scatter and increase plants of the second group rather than to eradicate them.

Spraying as a method of eradication should be demonstrated, using sprays for dandelion, mustard and wild onions. Reference should be made to the following Bulletins: Purdue Extension Bulletin No. 24, Purdue Extension Leaflet No. 22, Purdue Circular No. 32, Purdue Bulletin No. 176. Wisconsin Circular No. 48.

Additional Exercises in Crops.

(51) Proportion of Grain to Cob—

Shell an ear of corn, tabulate the following: Total weight, weight of kernels, weight of cob, per cent. of cob. Get the average for several ears. Compute the same for one bushel of corn.

(52) Shrinkage of Corn—

Take ten ears of corn from field. Weigh. Weigh every ten days for two months. Calculate loss of moisture in 1,000 bushels.

If corn is worth sixty (60) cents at husking time what price must it be two months later to bring the same amount as at husking time?

(53) To Show How Food from the Soil Gets to the Leaves—

Secure a growing stalk of corn, and cut at first node above the adventitious roots. Cover cut end with vaseline as soon as cut. Remove the vaseline, put cut end in red ink or red dye. Allow to stand for twenty-four hours. Note results. Sketch a cross section of the stalk.

What is the inference?

(54) To Find Volume of Soil to Nourishment—

Dig up a corn plant, get as many of the roots as possible. Using the mean of the three longest roots as a radius, calculate the volume of soil from which the plant received its nourishment.

Formula— $\frac{\frac{1}{6}\pi D^3}{2}$

(55) Study of Varieties of Corn—

Secure several samples of different varieties.

Compare—

1. General shape of ear and size.

2. Proportion of grain to cob.
3. Shape of kernel.
   (a) Length.
   (b) Width.
   (c) Thickness.
4. Contents of kernel.
   (a) Much or little protein.
   (b) Shape and size of embryo.
5. Indentation.

(56) Effect of Fertilizer on Early Growth of Oats Plant—

Fill ten jars (or buckets, 3 gallons is best, a one gallon will do) with field loam. Apply fertilizer as follows:

1. Check.
2. Potassium.
3. Nitrogen.
4. Phosphorus.
5. Check.
6. Potassium $\frac{1}{2}$, nitrogen $\frac{1}{2}$.
7. Potassium $\frac{1}{2}$, phosphorus $\frac{1}{2}$.
8. Nitrogen $\frac{1}{2}$, phosphorus $\frac{1}{2}$.
9. Nitrogen $\frac{1}{3}$, phosphorus $\frac{1}{3}$, potassium $\frac{1}{3}$.
10. Check.

Allow to grow for three weeks, watch results with reference to germination, growth, size of blade and color.

(57) To Test Wheat for—

1. Starch, add a drop of diluted iodine. Make enlarged sketch of grain, shade part affected most by iodine. (Where is most of the starch in the wheat located?) Material (Iodine H. N. O, 3.) (Seed should be soaked for several hours.)

2. Protein, cut a lone section at right angles to the grove add a drop of nitric acid. (H. N. O., 3.)
(Sketch seed and shade part most affected by the acid.)
(Do you fine as much protein as starch in wheat?)

(58) Varieties of Potatoes and Treatment for Scab—

Secure samples of seed potatoes.

Record—Length, shape (cylindrical or flattened), color, general appearance, size of eyes, depth of eyes, color of eyes, variety—early, late or medium.

For scab treatment dissolve 2 oz. of corrosive sublimate in 15 gallons of water, soak whole potatoes for six hours.

(59) Effect on Germination of Treatment for Smut in Oats—

Part 1. Treatment.

(A) Weigh out four lots, any weight (2 oz. or 57 grs.) or $\frac{1}{2}$ bu.

Lot. 1. Formalin treatment: Take one lot, sprinkle or dip oats in $2\frac{1}{2}$ parts formaldehyde to 1,000 parts water or formalin at rate of 1 lb. to 50 gallons of water. Soak for thirty minutes, then dry.

Lot 2. Hot water treatment: Take a second lot, soak for ten minutes in water 133° F. Spread out to dry.

Lot 3. Copper sulphate. (Rate, 1 lb. to 5 gallons water.) Soak for ten minutes.

Lot 4. Untreated.

Part 2. Using 50 grains from each lot, 25 hulled, 25 unhulled, Germinate seeds. Tabulate—

GERMINATION TEST.

Number of hours.....
Lot 1 Unhulled .....
Lot 1 Hulled .....
Lot 2 Unhulled .....
Lot 2 Hulled .....
Lot 3 Unhulled .....
Lot 3 Hulled .....
Lot 4 Unhulled .....
Lot 4 Hulled .....

From data obtained how much seed should be sown of each of the treated lots to get the same rate per acre as the untreated lot?

(60) Make a collection of hays or go to several barns. Score hay under following classes—

Choice Timothy:

Not over 1/20 other grasses, properly cured, bright natural color, sound, well baled.

No. 1. Not over 1/8 other grasses or clover, properly cured, good color, sound, well baled.

No. 2. Not over 1/4 other grasses or clover, fair color, sound, well baled.

No. 3. Shall include all hay not good enough for other grades, sound and well baled.

No grade. Shall include all hay badly cured, stained, thrashed or in any way unsound.

For grades of clover, address—

National Hay Association,
Chicago, Illinois.

(61) Make a sketch of your home farm or imagine an eighty-acre farm of six fields, make

1. A three-year rotation.
2. A four-year rotation.

(62) Make a test plat on a wheat or oats field where clover is to be sowed. This should be laid off about the middle of February. The manure, lime and potassium applied a little later.

(63) Make a list of farm crops for your community.

Secure the following data.

(a) Number acres in township.
(b) Valuation of crop. January 1st.
(c) Number acres in state.
(d) Average yield per acre.

(a) and (b) can be secured from the Township Assessor.

(c) and (d) can be secured from the State Statistician, Indianapolis.

Horticulture for High Schools.

(18 Weeks.)

This course is outlined to occupy one semester of eighteen weeks and to require three forty-minute recitations and two eighty-minute laboratory periods per week. The entire course is given to the subject of Pomology.

1. Definition of the term Horticulture.
2. Branches of the subject.
   (a) Pomology, olericulture, floriculture, and landscape gardening.
3. Objects of this course.
   (a) To learn some of the science connected with the successful growing of fruits and to be able to put this into practical use.
4. History of Horticulture in the United States and especially in Indiana.
   (a) One hundred years ago: Freedom from disease, lack

of transportation facilities, lack of storage facilities, general neglect of the orchards.

(b) During the last decade: Advent of disease, decrease in production of good fruit, orchards still neglected, injurious insects make their advent and do great harm.

(c) The present: "Knowledge is power." Great interest being shown in fruit growing, scientific knowledge is available by which the enemies of the industry may be successfully combated, modern storage, special transportation facilities, thousands of acres being set to fruit, fruit growing societies and fruit shows.

5. Men and institutions connected with the development of Horticulture.

(a) John Chapman, Ephriam Bull, Luther Burbank, John Dufour and others of special interest.

(b) Purdue University, all the state experiment stations and the United States Department of Agriculture.

6. Great fruit growing sections of the United States.

(a) Learn the fruit or fruits for which each section is noted.

(b) Pay particular attention to the Central States and especially to our own State.

7. Soil and Climate in relation to successful fruit growing.

(a) Fruits differ in their soil requirements the same as other crops or even more so, for they even differ according to varieties of the same fruit. Briefly outline the general soil adaptation of our common fruits.

(b) Climate must always be taken into consideration on account of length of season, rainfall, prevailing winds, extremes of heat and cold, average temperatures, frosts, winter killing, etc. Emphasize these facts by illustrations.

(c) Frosts—How to foretell them and ways of preventing injury from frosts.

8. Propagation of plants.

(a) Seeds—Reproducing true from seed, as the most of our vegetables.

(b) Seeds—Reproducing but not true to type and later budded or grafted, as the most of our fruit trees.

(c) Cuttings:

1b. Stem—Grape, gooseberry, currant, etc.

2b. Root—Red raspberry, blackberry, etc.

(d) Offsets and Divisions—Red raspberry, strawberry, etc.

(e) Layerage—Grapes, currant, gooseberry, black raspberry, etc.

(f) Grafting:

1e. Grafting proper—Apple, pear and quince.

2e. Budding—Peach, plum, cherry, apple, pear and quince.

9. Bearing habit of fruits.

(a) How to tell fruit buds by shape and size.

(b) Time of formation of fruit buds on the different fruits.

(c) Location of fruit buds on the different fruits.

(d) Cause of non-production of fruit:

1d. Lack of pollination, too vigorous growth of wood, disease, winter injury, rain during time of blooming, self-sterility.

2d. How to aid in overcoming these difficulties.

(e) Explanation of the June drop.

(f) Thinning the fruit: Reasons, time and extent of the operation. Effect on remaining fruit and on the tree.

10. Pruning, general principles relating to.

(a) What is meant by pruning.

(b) Reasons for pruning—Habit of growth in plants, natural pruning by the plant itself, survival of fittest among the branches; to modify the shape or extent of growth.

(c) Effect of pruning upon a tree—Length of life, growth, shape, fruiting habits and the fruit itself.

(d) When to prune—Regularly and lightly:

1d. Summer pruning and its effects.

2d. Winter pruning and its effects.

11. Variety selection of fruits.

(a) Points to consider: Season of maturing, age of trees coming into bearing, keeping and eating qualities of the fruit, habit of growth of tree, susceptibility to disease, soil adaptation, climatic adaptation, longevity of tree, personal taste or public demands.

12. Fungous diseases of plants.

(a) Number of plant diseases: Numerous, but fortunately each disease is generally limited to one species or at most to a few related species.

(b) Disease named after the effect it produces: Rots, smuts, rusts, mildew, blights, and wilts. Not all rots are related nor all smuts, nor all rusts, etc.

(c) Effect of each of the above kinds of disease on the plant attacked, and how it is propagated and spread.

(d) Examples of each of the above.

(e) Miscellaneous diseases requiring special notice. Black knot of plum, fire blight, peach yellows, peach leaf curl, and others of importance.

(f) Methods of controlling. Three ways:

1f. Removing and destroying the affected parts of the plant.

2f. Preventing spore germination.

3f. By killing the fungus itself.

4f. "An ounce of prevention is worth a pound of cure."

(g) Sprays suitable to use in overcoming these diseases:

1g. Bordeaux.

2g. Lime-sulphur.

13. Insects injurious to fruits.

(a) Definition of an insect.

(b) Leading classes of insects.

(c) Explanation of the life cycle of insects—metamorphosis.

(d) Harm done by insects: Amount financially; stage of life of the insect when it does the harm; how they do the harm—chewing or sucking.

(e) Why it is essential to know the life history of an insect and how it does the harm.

(f) How to help overcome harmful insects:

1f. Encouragement of birds.

2f. Encouraging helpful animals.

3f. Banding trees.

4f. Applying washes.

5f. Burning all rubbish.

6f. Using poison baits.

7f. Knowing helpful insects which kill the harmful ones.

8f. Spraying with the right thing at the right time.

(g) Some insects worthy of special study: Study their life history, and method of controlling them.

San Jose scale, oyster shell scale, scurfy bark scale, codling moth, plum curculio, peach borer, flat-headed apple tree borer, round-headed apple tree borer, bark beetles, canker worms, plant lice, cherry and pear slug, fall webworm, apple tree tent caterpillar, currant worms, and all others found to be destructive in your community.

(a) Classes of sprays:

1a. Fungicides.

2a. Insecticides—Stomach and contact poisons.

(b) Spray material and their uses:

1b. Arsenate of lead.

2b. Paris green.

3b. Hellebore.

4b. Copper sulphate (Bordeaux).

5b. Pyrethrum.

6b. Tobacco (in different forms).

7b. Soaps.

8b. Sulphur.

9b. Others of local use.

(c) Spray machinery for liquids:

1c. Pumps, tanks, agitators, hose, nozzels, etc.

(d) Pressure at which spray should be applied.

15. Cultural directions and miscellaneous notes on the apple.

(a) Origin and botanical relations.

(b) Propagation.

(c) General soil adaptation.

(d) Age tree to buy, where to buy, when and how to transplant.

(e) Location of the apple orchard.

(f) Management of apple orchard.

(g) Fruiting habit.

(h) Pruning.

(i) Spraying.

(j) Suitable varieties for your locality—early, mid-season, early winter, and late winter.

(k) Harvesting and storing:

1k. When harvested, how harvested, and tools used.

2k. Essentials of good storage—right temperature, good ventilation, and right amount of moisture.

3k. Methods of storing—cellars, pits, and cold storage.

(l) Diseases and insect pests:

11. Remedies for the above.

(m) Uses of fruit in the home.

(n) Marketing surplus fruit.

1n. Methods and markets open to the farmer or fruit grower.

16. Pears.
17. Peaches.
18. Cherries.
19. Plums.
20. Quinces.
21. Grapes.
22. Blackberry and dewberry.
23. Raspberry.
24. Currant.
25. Gooseberry.
26. Strawberry.
27. Any other fruit of local interest.

(a) Follow the outline given for apples but change where necessary to conform to the fruit being studied.

28. Planning an orchard.

(a) Purpose of an orchard.

(b) Kinds of fruits wanted.

(c) Approximate number of trees wanted to supply the amount of the different fruits needed.

(d) Amount of ground needed or that can be given to the orchard.

(e) Location of the orchard—Consider soil, water drainage, air drainage, slope of the land, distance from the house and from the place of storage.

(f) Preparation of the land—Well prepared ground is essential to the success of the orchard.

(g) Plan of planting—Square system, hexagonal, and quincunx systems; the use of fillers.

(h) Ordering tress, etc.; when, where, age to buy.

(i) Care of trees previous to setting out.

(j) Planting—when and reasons:

1j. Digging holes and cost—by hand or with dynamite.

2j. Act of planting: pruning roots, placing in hole, filling hole.

3j. Pruning the top depends upon age of tree.

(k) Care of tree during the first summer.

1k. Protection and cultivation.

(l) Care of trees until they come into bearing, which will be about the seventh year; repairing injured trees, cultivation, spraying, pruning, etc.

29. Management of fruit orchard.

(a) Clean culture-cover crop—When plowed, how cultivated, when to sow cover crop, suitable cover crops, kind of land suited to this system and its advantages.

(b) Sod-mulch—Explanation, adaptation, advantages and its disadvantages.

(c) Pasturing—Hogs, sheep and poultry at certain times, but other kinds of livestock not desirable.

(d) Intercropping—Crops suited to be grown as intercrops

1d. Vegetables all right, but cereals should not be used.

(e) Protectors—Reasons for using.

1e. Wire cloth, tarred paper, etc.

(f) Fertilizing—Barnyard manure, cover crops, and commercial fertilizers.

30. Renewing old orchards.

(a) Present conditions.

(b) Is it worth renewing—50% of the trees should be healthy varieties and the location should be satisfactory.

(c) Reasons for the condition of the orchard.

1c. Ignorance and neglect; trees too close; lack of plant food; lack of regular pruning, and very often an entire lack of spraying.

(d) How to renew an orchard.

1d. Get acquainted with the causes of decline.

2d. Consider how to remove these causes.

3d. Best time to begin is in the fall. Identify the varieties, make a working plan, and mark all worthless trees for removal.

4d. Remove worthless trees during early winter.

5d. Prune with care the remaining trees.

6d. Haul and burn all rubbish.

7d. Spray about the middle of March and continue the schedule throughout the season.

8d. Plow, disc, and harrow as early as possible in the spring and practice the clean cultivation-covered crop method.

9d. In case it is not advisable to plow then leave in sod but do not pasture nor make hay.

10d. Add plenty of barnyard manure, or if this is not available apply about 500 pounds per acre of a 6-12-10 commercial fertilizer.

11d. Continue pruning and begin top working during the second winter and spring.

12d. Spraying, cultivation, and fertilizing should be carried on each succeeding season.

31. Marketing the surplus fruit.
   (a) Sorting and grading.
   (b) Packing.
   (c) Markets.
   (d) How and to whom sold.

32. Laws of Indiana that affect the fruit grower.
   (a) Weights per bushel.
   (b) Condition of fruit on the markets.
   (c) Diseases and insects on nursery stock.

33. Indiana as a fruit growing state.
   (a) Soil and climate.
   (b) Price of land compared to other fruit growing districts.
   (c) Quality of Indiana applies.
   (d) Returns from investment compared with other crops.
   (e) Markets open to Indiana as compared to other fruit districts.
   (f) Cost of placing the fruit on the market, compare with the western grower.
   (g) Storage facilities in Indiana.
   (h) Parts of Indiana especially adapted to fruit growing.
   (i) Why we have not given more attention to fruit growing.
   (j) Fruit growers associations and their work.

34. Cost of bringing an orchard into bearing and making it a paying proposition.
   (a) Cost of trees.
   (b) Fitting land.

(c) Setting trees.
(d) Fertilizing.
(e) Cultivating.
(f) Cover crop.
(g) Pruning.
(h) Burning brush.
(i) Spraying.
(j) Incidentals.
(k) The total cost should be reckoned on the above basis.

Laboratory Exercises in Pomology for High Schools.

Numbers in parenthesis refer to corresponding numbers in course of study. Exercises are not necessarily to be followed in the exact order as given. Should be seasonal.

1. (6) Furnish each pupil an outline map of the United States and have him outline in blue ink the important fruit growing districts. Write on each district its characteristic fruits.

2. (7) Make one or more field trips and examine the soils of the community and discuss their adaptability to fruit growing.

3. (7) Prepare a weather chart, noting the length of the growing season, early and late frosts, rainfall and extremes of temperature.

4. (7) Make a psychrometer and make observations.

5. (8) Make a field trip and point out to the pupils the different fruits that have been propagated by the different methods.

6. (8) Make stem cuttings of gooseberry, currants and grapes.

7. (8) As a part of the permanent work plant several peach seeds from the same tree and do not bud them. This will be a good lesson in variation and where room is available could be further carried out with apples, gooseberries and currants (could be done at home by pupil.)

8. (8) Propagate blackberries by root cuttings.

9. (8) Study and set out plants that have been propagated by layering.

10. (8) Stratify peach seeds to be planted for budding.

11. (9) Make a field trip and observe fruit buds on the different kinds of fruit trees.

12. (9) Make sketches of twigs of different fruits, noting leaf and fruit buds.

13. (10) Make a field trip and observe what has been said about pruning—method of making cuts and results; self pruning,

—lack of pruning and results; irregular pruning and results, etc.

14. (1) Have each pupil report on varieties of fruits found at home. Varieties of fruit found on market.

15. (12) Either make field trips or have specimens of diseased plants brought to the laboratory and teach the scholars to identify them, and learn their life history and methods of controlling them.

16. (12) Prepare Bordeaux Mixture.

17. (13) Through specimens gathered the preceding summer illustrate the different ways in which insests harm plants. Show the three or four stages of some insect (Potato beetle is easily secured.)

18. (13) Band some trees in early spring with tanglefoot and some with burlap. Examine from time to time. Note insects trapped.

19. (13) Dilute commercial lime-sulphur for winter and summer spraying with the aid of the hydrometer.

20. (13) Make a spay of arsenate of lead alone, then of Bordeaux and arsenate of lead. Make a spray of nicotine solution. Learn the uses of each of the above.

21. (13) Either through mounted specimens or pictures or field trips, learn to identify the insects that have been studied.

22. (14) Examine different forms and kinds of spray materials.

23. (14) Examine as many different kinds of spraying machinery as you find in your community and learn what it takes to do efficient work in the way of nozzles, agitators, hose, pumps, etc.

24. (14) Do some spraying of a practical nature if possible and figure on the amount of material and the time required to spray one tree and then to do 50 trees, etc.

25. (15) Have each child furnished with at least five seedling apples suitable for root grafting. Get scions from suitable varieties and graft them. Store these and next spring allow each pupil to take them home and set them out.

26. (15-16) Prune apple and pear trees for the people of the community.

27. (17) Prune peaches at proper season.

28. (21) Prune grapes at proper time.

29. (22-23-24-25) Prune bush fruits found in the community.

30. (26) Illustrate staminate and pistilate strawberries and make drawings of flowers.

31. (28) Make a field trip and pick out several suitable locations for orchards.

32. (28) Make drawings of the different systems of planting and discuss good and bad features.

33. (28) Make a drawing of a one or two-acre home orchard, locating definitely the place of each kind of tree and giving the kind and variety.

34. (28) Make a trial order for the above orchard and figure the cost of the trees.

35. (28) Set out some apple or other fruit trees at the proper time, either on the neighboring farms or on the school grounds.

36. (28) Go to a neighboring field and lay out in regular size one or two of the best planned orchards as made in exercise No. 32.

37. (29) If possible visit two orchards that were set last year (one clean culture, the other "just set out") and note difference in trees. Observe older orchards on same basis.

38. (29) Make some wire cloth and tarred paper protectors.

39. (30) Visit an old orchard and try to do as much of the work as outlined in lesson thirty as possible. If possible take over a small orchard and carry the work on from year to year.

40. (30) Do plenty of top working with apples and pears.

41. (31) Visit markets and note methods of packing fruits. Find out the freight cost to the nearest large markets. Learn names of reliable commission men.

42. (32) Weigh out a bushel of apples and then measure them or vice versa. How many pounds in a bushel of apples. Get samples of strawberry boxes and other fruit boxes and test them for accuracy.

43. (33) Make a problem involving the question of returns from investment as compared with other crops.

44. (33) Using outline maps (Lab. exercise 1-(6)) of the U. S., join your railroad station with the leading large cities by means of red ink. Learn the distance and write along this line, then find out freight rates and make note of this below the map. Compare your available markets with those of the other leading districts as regards cost of shipping and distance.

COURSE IN VEGETABLE GARDENING FOR HIGH SCHOOLS.

(36 Weeks and Summer Work.)

September.

Extent of vegetable industry. Types of vegetable growing—Home gardening, Market gardening, Truck farming.

Factors Influencing Location—Home garden—south slope, well drained, near house; Market garden—soil, markets, roads, price of land etc.; Truck farm—soil, roads, railroads, etc.

Storage of Vegetables.

Objects of Storing. Harvesting Vegetables to be Stored. Storage Requirements of Different Vegetables:—Root crops and cabbage—cool, moist, no circulation; Onions—cool, dry, good circulation; Sweet potatoes, squash, pumpkins—warm, dry, good circulation.

Storage Houses. Pits and Outdoor Cellars. The House Cellar. Cold Frames.

Cultural Requirements of Each of the Common Vegetables.

October.

This should be a detailed study of each vegetable including: climatic requirements, soil, importance, planting, cultivating, harvesting, marketing, yields and returns, fertilizing, varieties, and enemies.

Several planting problems may be assigned in connection with this work.

The vegetables should be studied in the following order, classified according to cultural requirements:

Cool Season Crops.

Shorts Season Crops—

Can not endure heat of summer but can be planted in open ground sufficiently early to mature before hot weather: Radish, spinach, peas, leaf lettuce, kohlrabi, green onions, garden cress.

Long Season Crops—

Require cool, moist weather during earlier stages of development, but can endure considerable heat after becoming established: Beets, carrots, celery, chard, kale, leeks, onions, parsley, parsnips, early potatoes, salsify.

Crops Requiring Transplanting—

Cannot endure heat, yet growing period is so long that they would not complete growth before hot weather if seed were sown in open ground. Consequently must be started earlier in hotbeds or greenhouses and transplanted: Early cabbage, early cauliflower, head lettuce.

November.

Warm Season Crops.

Short Season Crops—

Sufficiently short period of growth to enable them to be planted in open ground and mature during normal warm season: String beans, lima beans, sweet corn, okra, cucumbers, muskmelons, watermelons, squash pumpkins.

December.

Crops Requiring Transplanting—

Growing period so long that plants must be started under glass in advance of warm season and transplanted to field when weather is favorable: Eggplant, pepper, sweet potato, tomato.

Perennial Crops.

Asparagus, Rhubarb.

January.

Selection of Varieties and Purchasing Seed.

Sources of seed. Importance of good seed. Quantity of seed required. Seed Testing.

Insect Enemies and Diseases.

Classes of Insects, Chewing, Sucking.

Methods of Controlling Insects, Hand Picking, Spraying.

Study of Spray Materials and Machinery—

Diseases: Methods of Control, Spraying, Crop Rotation, Resistant Strains.

Soils for Vegetables.

Light warm soil for early vegetables, Loose soil for root crops, Muck soil for onions and celery. How is local soil adapted to vegetable growing?

February.

Fertilizers for Vegetables.

Even the richest soils must be fertilized with manure and chemical fertilizers to produce maximum crops of vegetables.

Stable Manures: Value as Fertilizer, Composting, Time and rate of application.

Commercial Fertilizers: Nitrogen, Phosphorus, Potassium. Sources, uses, rate of application and method of application. Green manures and Cover Crops. Use of Lime.

Tools and Implements.

Hand tillage tools and implements; Horse tillage tools and implements; Care of tools.

Planting.

Preparation of seed bed; requirements for germination; time of planting, method of sowing, broadcasting, hand sowing in drills, planting machines, planting distances.

Transplanting.

Objects of transplanting; seed bed preparation; when to plant; starting plants in greenhouse, hotbed, or window box; method of transplanting; hand methods; transplanting machines; use of flats, pots and dirt bands; depth to transplant; watering and shading.

March.

Hotbeds and Cold Frames.

Types of Hotbeds—Manure heated, Flue heated, Steam heated. Construction of Hotbeds—Pit hotbeds, Surface hotbeds.

Location of Hotbeds—South side of building.

Construction and Types of Cold Frames. Hotbed sash, mats, etc. Uses of hotbeds and cold frames. Care of hotbeds and cold frames.

Tillage.

Objects of Tillage—Conserve moisture, Make plant foods available, Kill weeds.

Advantage of fall manuring and plowing, disking, harrowing, dragging, cultivation, maintain dust mulch; weeding.

Irrigation.

Objects and Benefits, Furrow system, Hose applications in home garden, Overhead System.

April.

Systems of Intensive Cropping.

Companion Cropping, Succession Cropping.

Marketing Vegetables.

Types of Markets—Local special markets, Local general market, Distant general market.

Preparation of Vegetables for Market—Harvesting, Method, time of degree of ripeness, etc.; Washing and bunching, Grading, Packing, Types of Packages, Packing Sheds and Houses. Selling to Consumer, Establish a Route and definite days of selling, market wagons. Rules of Public markets. Selling to Retailer, Selling to Wholesaler, Shipping, Commissions.

May to September.

Canning Vegetables.

Vegetables adapted to canning, Harvesting and degree of ripeness, Preparing vegetables for canning, Canning Apparatus, Home outfits. Discuss in detail Commercial Outfits, Containers, Methods of Canning at Home, Canning Clubs, Labeling, Laws relating to canned goods, Marketing canned vegetables.

OUTLINE OF LABORATORY EXERCISES FOR COURSE IN VEGETABLE GARDENING FOR HIGH SCHOOLS.

(36 Weeks and Summer Work.)

Each student to have a garden of not less than one-tenth acre. Hotbeds to be made in school yard. Other gardening work to be done individually and each exercise reported in a written report or note book. Records to be kept of expenses, receipts, and profits or losses. Two laboratory exercises per week.

LABORATORY EXERCISES.

September.

1. Visit a market garden in the vicinity and note how fall crops are handled, planting arrangement, soil and location. Get definite idea of small, average, and large yield of various crops, and of prices and costs of production. Have pupils figure profits to stimulate interest.

2. Visit a few home gardens, noting size, soil, location assortment and arrangement of crops.

3. Visit markets and note assortment of vegetables, prices packages, and where they were grown.

4. Visit another market garden or truck farm taking similar notes as before and comparing the two farms.

5. Harvest sweet potatoes and store some in school furnace room, also store squash and pumpkins there. (Get permission to harvest these crops on some farm and buy them in the field.)

6. Select home garden site. Measure and describe location, soil, etc., and test soil acidity.

7. Dig potatoes and root crops. If some one in the vicinity has special digging machinery visit his place.

8. Make storage pits for potatoes and tender roots, such as beets, carrots, turnips. Buy these vegetables and make pits at school. Can be sold later when pits are opened.

October.

9. Make storage pits for cabbage.

10. Make storage pits for hardy root crops.

11. Remove all refuse from previous crops on garden site.

12. Apply manure to garden site at rate of at least 20 tons per acre.

13. Examine fertilizer distributors.

14. Apply phosphate and potash fertilizers if necessary.

15. Plow under manure.

16. Study various garden seeds and identify them.

November.

17. Study garden seeds.

18. Visit market gardens and note fall work.

19. Make planting plans of a ten acre truck farm raising vegetables studied thus far.

20. Make planting plans of these vegetables in the home garden.

21. Open storage pits for Thanksgiving vegetables.

December.

22. Planting plans of a market garden. Let student choose his own location, size of farm, crops, etc. Discuss plans submitted.

23. Make planting plans of the student garden plots. Discuss various plans.

24. Adopt final plan of student home gardens and have each one copy this plan and follow it later.

25. Open storage pits and examine stored vegetables.

January.

26. Determine amount of seed required for each home garden. See tables showing quantity of seed required per 100 feet of drill, etc.

27. Study seed catalogs, determine varieties, and order seed.

28. Make Bordeaux mixture.

29. Test Paris green and demonstrate methods of mixing arsenate of lead.

30. Prepare germination test of seeds.

31. Make drawings of preserved specimens of worst insect pests, such as striped cucumber beetle, potato beetle.

32. Cutworms, squash bug, maggots, etc.

33. Make drawings of specimens of important plant diseases, such as club root cabbage, onion smut, downy mildew on cucumbers.

February.

34. Anthracnose of beans, leaf spot of tomatoes, etc.

35. Prepare germination tables from seed tests.

36. Study diseases.

37. Examine wheel hoes and their attachments, weeding machines, etc.

38. Test seed drills on laboratory floor and examine other garden implements.

39. Construct "flats" 3-16-22½ inches. Four flats per pupil.

40. Construct indoor window boxes. Fill with prepared soil.

41. Sow seeds of lettuce, cabbage, and tomatoes, in window boxes, and sow celery in flats. Three flats for entire class.

March.

42. Make hotbeds. Place manure and set up hotbed frame and bank with manure. Might make one pit hotbed and one surface hotbed. Build hotbeds at school for entire class, and detail squads for daily care of hotbeds. Watering, ventilating.

43. Apply lime to home gardens.

44. Put 4 inches of loam in hotbeds. Rake smooth. Repair sash if necessary. Put on sash and show methods of opening for ventilation on leeward side.

45. Each pupil plant radishes in one portion of hotbed.

46. Plant asparagus roots and rhubarb in furrows 8 inches deep.

47. Visit market gardeners and note hotbed crops and preparation for spring.

48. Mix soil for flats. Each pupil transplant ½ flat of head lettuce, and ½ flat of cabbage. Set plants 2 by 2 inches.

49. Each pupil shift a flat of tomatoes 2 by 2 inches. Put flats in hotbed. Treat seed potatoes with formalin for scab.

50. Disk, harrow and drag gardens.

51. Plant radishes, spinach, lettuce seed, onion seed and peas in home garden.

April.

52. Plant beets, carrots, parsnips, turnips.

53. Plant potatoes, and onion sets.

54. Transplant cabbage and head lettuce from flats to home garden.

55. Shift celery seedlings to flats 2 by 2 inches. Three flats per student. Put flats in cold frame.

56. Shift tomatoes to hotbed. Set plants 6 by 6 inches.

57. Cultivate with a wheel hoe and hand hoe all crops that have come up. Plant later peas (wrinkled varieties).

58. Cultivate all crops and study seedlings. Have unplanted portion of garden harrowed.

May.

59. Plant string beans and sweet corn.

60. Cultivate everything. Begin hardening off tomatoes in hotbed.

61. Cultivate and weed and study seedlings. Harrow unplanted land.

62. Transplant celery from flats to garden. Harvest radish, leaf lettuce and spinach. Bed sweet potatoes for slips in hot bed.

63. Plant cucumbers, melons, lima beans, squash and pumpkin.

64. Transplant tomatoes from hotbed to garden.

65. Cultivate everything. Harvest earliest crops.

66. Thin and weed onions, beets, carrots, parsnips, turnips, etc.

June.

67. Harvest head lettuce, bunch onions, peas, etc. Finish thinning and weeding of root crops.

68. Plant sweet potatoes in garden.

69. Spray cucumbers and potatoes.

70. Cultivate everything.

71. Demonstrate canning outfits.

ANIMAL HUSBANDRY.

High School Course.

(18 Weeks.)

1. Definition and Importance of Animal Husbandry, Relation to agriculture.
   Demonstration Exercises: Judging draft horses.
2. Types and Breeds of Horses.
   Draft horses, carriage horses, speed horses and other types.
   Demonstration Exercises: Judging draft horses.
3. Breeds of Horses (Continued).
   Demonstration Exercises: Judging draft horses.
4. Types and Breeds of Cattle.
   One-fourth of time to type and three-fourths to breeds.
   Demonstration Exercises: Judging draft horses.
5. Types and Breeds of Swine and Sheep.
   One-fourth time to types and three-fourths to breeds.
   Demonstration Exercises: Judging draft horses.
6. Livestock Breeding.
   Demonstration Exercises: Judging draft horses.
7. Livestock Breeding (Continued).
   Demonstration Exercises: Judging light horses or driving horses.
8. Livestock Breeding (Continued).
   Demonstration Exercises: Judging saddle horses and other types.
9. Livestock Breeding (Continued).
   Demonstration Exercises: Judging beef cattle, fat cattle, breeding cows and bulls.

10. Composition of Plants and Animals and Influence of Foods on the Body.
    Demonstration Exercises: Judging beef cattle (Continued).
11. Feeding Standards and the Calculation of a Balanced Ration.
    Demonstration Exercises: Judging beef cattle.
12. Coarse and Concentrated Feeds and Their Value.
    Demonstration Exercises: Laboratory study of feeds.
13. Care and Feeding of Horses.
    Demonstration Exercises: Judging fat and market hogs.
14. Care and Feeding of Horses (Continued).
    Demonstration Exercises: Judging fat and market hogs.
15. Care and Feeding of Fattening Cattle.
    Demonstration Exercises: Judging breeding sows.
16. Care and Feeding of Brood Sow and Young Pigs.
    Demonstration Exercises: Judging breeding sows.
17. Care and Feeding of Growing and Fatting Pigs.
    Demonstration Exercises: Judging fat sheep.
18. Care and Feeding of Sheep.
    Demonstration Exercises: Judging breeding sheep.

DAIRYING.

Course in Agriculture for High Schools.

I. Dairy Industry.
   A. Consideration of the early history of the dairy industry; development of a special milk producing animal and the sources of milk in different countries; from statistical reports make a study of the number of cattle in the United States and in Indiana; the value of their product and its comparison with that of various other farm products; the amount of dairy products imported and exported by this country and a brief consideration of the highly-developed dairy countries of the world; classification of the various methods of disposing of farm crops and its relation to conservation and to the maintenance of soil fertility.

II. Breeds of Dairy Cattle.
   A. Study the major and minor dairy breeds; their native homes and history; date and extent of importation into the United States, the dairy characteristics

of the various breeds and the advantages and disadvantages of each; the location of the pure breeds of dairy cattle in the United States and in Indiana; classify a record cow of each of the four major dairy breeds, both with respect to milk and fat production.

III. Dual-purpose Cattle.

A. Definition of the term, "dual-purpose" and its application to a type of cattle; classify the breeds and the history of each, that are capable of producing both beef and milk; the extent of this type of cattle in the United States and in Indiana; the consideration of the conditions necessary for the successful use of this type of individual; discuss the advantages and disadvantages of using this type of cattle in a district especially adapted to the production of either beef or milk; classify the home herd of cattle with respect to breeding and major production.

IV. Breeding.

A. History of the development of the improved strains of cattle and the lasting influence exerted by certain noted breeders; prepare a pedigree estimating the influence exerted by various individuals contained therein; special value of pure bred stock; use of the pure bred bull in grading up a herd; relation of record keeping to systematic breeding; estimate the number and breed of pure bred cattle in the neighborhood.

V. Feeding.

A. Discuss the purpose of feeding, composition of feeds, both from the standpoint of their physical and chemical composition; discuss the various characteristics necessary for an ideal ration; have pupils prepare a ration for milk cows, dry cows and heifers, placing special stress upon the amount consumed of the different feeds by the various classes of cattle.

VI. Compound Rations.

A. Definition of the terms, protein, carbohydrates and fat, balanced ration and nutritive ratio; discussion of the physical properties of a ration such as palatability, bulk and succulence, concentrates and rough-

age; and explanation of the meaning of feeding standards and the method used by the various investigators in expressing the qualities of a successful ration; from the ration suggested in previous period. have pupils determine nutrients contained therein; have records kept of feeds consumed and milk produced from these rations when fed to home herds.

VII. Comparison of Dairy and Grain Farming.

A. Have pupils report on the amount of the various crops grown upon the home farm also the number of cattle kept; discuss the advantages and disadvantages of feeding all crops grown in comparison with the system of disposing of all crops immediately after harvest; observe conditions of soil fertility on the two classes of farms, noting, also, the equipment needed in operating the two types of businesses.

VIII. Care and Management of Dairy Cattle.

A. Discuss conditions most favorable for maximum milk production with special reference to rations, comfortable surroundings and moderate temperature; note the season of the year that largest milk flow is usually obtained and analyze conditions usually prevalent at that season of the year; consider methods of supplying similar conditions during the remaining months of the year; have pupils report in regard to methods of housing and handling cattle on the home farm; advantages and disadvantages of each; equipment and method of supplying water; amount of pasture available; types of fences; shelter and shade considering the desirable and undesirable factors of each.

IX. Care of Milking Herd.

A. A review of the proper methods of feeding and milking; collect figures from pupils in regard to the size of the production of the herd on the home farm, average length of lactation period; discuss the value of individual feeding for dairy cows; regularity in milking and feeding and general sanitary precautions; the importance of growing heifer calves and the methods of feeding heifers and dry cows.

X. Care of Growing Stock.

A. Various methods of feeding calves; average birth weight of the various breeds and age of weaning; standard method of feeding calves and cost until six months of age; importance of growing dairy heifers and its influence on improving the quality of the milking herd; housing and cost of growing dairy heifers.

XI. Daily Record Keeping.

A. Have pupils prepare blanks designed to keep an accurate record of the milk produced and feed consumed by the various individuals that constitute the home dairy herd; also blanks for time employed in caring for herd; monthly summary sheets showing profit or loss, both feed and labor and returns for each dollar invested; pedigree blanks and tables for the recording of gestation periods.

XII. Dairy Barn Construction.

A. Discuss the essentials of dairy barn construction such as convenience, comfort, ventilation, light and cost; explain the types of barn such as the combination designed for the housing of cattle and horses, dairy barn, feed storage above, single story barn and roof barn; materials used in barn construction and dimension of frame; include a discussion of the silo and its relation to a properly arranged barn; have pupils prepare plans of barns used at home; have them rearrange same in accordance with previous discussion.

XIII. Milk Room Construction.

A. Discuss the needs of a milk room for the handling of dairy products; size and location of the milk room for the average farmer; materials used for construction; the importance of certain types of equipment such as the cooler, aerator, boiler, washing vats and rack for can and buckets, separator, milk scales, milk sheet and rack for Babcock samples.

XIV. Dairy Sanitation.

A. Discuss factors instrumental in the production of sanitary milk and its relation to public health with special reference to the influence exerted by the conditions of barn, milker, method of handling milk and the cleaning of utensils; explain the essentials and

nonessentials of the average sanitary regulation and impress, especially, the necessity for careful application of sanitary methods in the production of dairy products.

XV. Cream Separation.

A. Explain the principles involved in the various methods of cream separation, namely, shallow pan, deep setting, water dilution and centrifugal machine; have pupils report concerning types of separators in use at home; make a collection of illustrations of the various types of separator bowls; explain principles involved in the separation of cream through the use of a detailed drawing of one of the standard makes of separator bowls.

XVI. Buttermaking.

A. Explain the principles involved in churning cream and the extent of its use in manufacture; care of cream both with respect to sanitary surroundings and temperature; various types of churns both for farm and factory buttermaking; make a collection of illustrations of various types of churns; give complete instructions in regard to buttermaking from the time the milk is drawn from the cow until the butter is disposed of.

XVII. Diseases of Dairy Cattle.

A. Discuss the influence of milk produced by diseased cows upon the health of the consumer; common dis-diseases of dairy cows and home methods of treatment; discuss methods of controlling or preventing diseases also method of determining tuberculosis infection.

XVIII. Review of Term's Work.

COURSE IN POULTRY.

For High Schools.

(18 Weeks.)

This outline is based on three hours per week lectures, and two to four hours per week laboratories, for 18 weeks. It will probably be more applicable to upper classmen in the High School although it can be easily worked out to fit the needs of Freshmen.

1. Recitations.

First Week—

Recitations 1 to 3: General consideration of the poultry industry with its advantages and disadvantages, scope, opportunities, and combinations with other lines of agriculture. Local conditions studied with a view to suggesting improvements later in the term. The requirements of a successful poultryman. Conditions under which poultry should be developed, to be followed by carefully worked out bibliography.

Second Week—

Recitations 4 to 6: Nomenclature of bird; class, breed and variety characteristics, from both fancy and utility standpoints, with the hope of learning the reason for classifying birds and seeing the small detail parts of each kind. Charts and drawings to accompany this.

Third Week—

Recitation 7: Age, sex, and vigor. How to select the layer. The indications of age and sex and the strong and weak vitality characteristics. How these affect the points of selection of breeders and layers. Pelvic bone test for layers.

Recitation 8: Mating up birds for fancy and utility purposes.

Recitation 9: Origin and history of a few important breeds.

Fourth Week—

Recitation 10: Continuation of recitation No. 9.

Recitations 11 and 12: Housing. Principles of poultry house construction illustrated by laws of physics. Kinds of common lumber on the market.

Fifth Week—

Recitations 13 to 15: Housing. Prices of lumber, how to figure, measure and cut. Location of house, details concerning size and shape. Visit lumber yard.

Sixth Week—

Recitations 16 to 18: Housing. Details concerning walls, roof, roofing materials, floors and problems on cost of constructing same.

Seventh Week—

Recitations 19 to 21: Housing. Interior arrangements, equipment and appliances. Elementary work on concrete mixing. Advantages and disadvantages of different types of houses.

EIGHTH WEEK—

Recitations 22 to 24: Feeding; the things upon which possible egg production depend. Fundamentals of feeding. Definitions of food elements. Use or purpose. Where and how found and supplied.

NINTH WEEK—

Recitations 25 to 27: Feeding; different feeds and their uses. What a ration is. How it is figured. Essential of a ration. Influence of age, breed, season, purpose, environment, etc., and a laying ration.

TENTH WEEK—

Recitations 28 to 30: Feeding; figuring out rations. Fattening poultry. Purpose of. Where the profit is. Rations. Method of feeding.

ELEVENTH WEEK—

Recitations 31 to 33: Marketing poultry. Methods of killing, picking, and packing and shipping poultry. Abuses of same on the farm. Seasonal prices and their influence on profit.

TWELFTH WEEK—

Recitations 34 to 36: Marketing eggs. Conditions in the State. Methods now in vogue. Remedies. Grading, candling, testing, causes of bad eggs. How to improve quality.

THIRTEENTH WEEK—

Recitations 37 to 39: Incubation, natural and artificial. How to set a hen and feed her. Principles of incubation. Advantages and disadvantages. How to buy or construct. Heating and ventilating principles.

FOURTEENTH WEEK—

Recitations 40 to 42: Incubation, natural and artificial. How to set up. Rules for running. Development of chick in the egg. Testing.

FIFTEENTH WEEK—

Recitations 43 to 45: Brooding, natural and artificial. Caring for chicks with the hen. Building a large and small brooder. Comparative costs. How to care for chicks. Regulation of heat.

SIXTEENTH WEEK—

Recitations 46 to 48: Diseases. Caponizing. Principles of sanitation and influence upon health. How to prevent disease.

Common diseases and their symptoms. Causes and cures. How and when to caponize.

Other weeks not suggested are for the use of tests, reviews, etc.

(2) Demonstration Exercises.

1. Trip to neighboring flocks.
2. Class characteristics. Nomenclature. Birds should be brought into laboratory and students supplied with a key with which to indentify the different classes, by their characteristics.
3. Breed characteristics. Differences in shape. Pupils should be supplied with a key giving breed characteristics. It is advisable to ask the pupil to name the class with the breed and thereby review the previous week's knowledge.
4. Variety characteristics. The key giving the different variety characteristics should be available, and students asked to name the class and breed along with the variety.
5. Drawing of good and bad specimens of different kinds of feathers and the different kinds of single and rose combs, etc.
6. Age, sex, vigor, and pelvic bone test. Students asked to give the age of the bird, its sex, and whether strong, fair, or weak in vitality. Pelvic bone test should be used to determine whether or not the hens are laying at that time.
7. Review of preceding laboratory periods without the use of notes.

8-10. Building feed hoppers, trap nests, catching hooks, and a fattening crate.

11. Identifying feeds. Naming their uses by means of a key.
12. Mixing feeds for different purposes.
13. Drawing and naming parts of raw egg, broken on a saucer, and a boiled egg cut longitudinally.
14. Testing and grading eggs for commercial purposes.
15. Comparative judging of eggs.
16. Examining and measuring an incubator.
17. Examining and measuring a brooder.
18. For any loss that may occur.

FARM MECHANICS.

For High Schools.

(18 Weeks.)

(Three class and two laboratory periods per week.)

I. Rope Work (Demonstration Practice).

1. Equipment—

18 feet of 1/2 inch rope for each student.

2. Exercises—

Whipping or seizing end of rope.
Coiling and uncoiling end of rope.
Square knot. (Distinction between square and granny knot.)
Weavers knot.
Hitching tie.
Halter tie.
Single bowline.
Double bowline.
Emergency trip.
Clove hitch or millers knot.
Blackwall hitch.
Review of knots.
Crown splice.
Eye splice.
Short splice.
Rope halter.
Long splice.

II. Soldering.

1. Equipment—

Blow torch, gasoline heater or charcoal pot.
Soldering copper, tin snips and an old file.
Solder, powdered sal-ammoniac and soft brick.
Muriatic acid and scrap zinc and damp waste.

2. Exercises—

Prepare the soldering flux.
Dissolve scrap zinc in muriatic (hydrohloric acid).
Tin the copper (coat the point with solder).
Practice soldering two strips together.
(All parts to be soldered must be thoroughly cleaned and soldering flux spread freely over the parts.)
Repair a tin or copper vessel which leaks.
Make a tin box or funnel.

III. Corn Planters.

(A comparative study should be made on two planters.)

1. General Study of Parts—
   - (a) Frame, rigidity, durability, and oiling devices.
   - (b) Furrow openers:
     Type-advantages and disadvantages.
     Distance apart of openers, convenience and range of movement.
   - (c) Plates:
     How driven—movement continuous or intermittent.
     Method of changing number kernels to hill.
     Adjustment necessary to change from checking to drilling.
   - (d) Valves in shank:
     Number of valves—object.
   - (e) Wheels:
     Type (solid, open or double) height.
   - (f) Wire reel:
     Method of driving reel.
2. Calibration of Planter—
   Select a plate which will give the highest efficiency with corn at hand. Test planter for 300 hills and count number hills of 1, 2, 3, and 4 kernels.

IV. Binders.

1. A comparative study of two or three binders—
   a. Frame—Rigidity, durability, provision for taking up wear, oiling devices, folding of dividers and convenience of levers.
   b. Size—Width of cut. Width of cutter bar.
   c. Wheels—Master wheel, height; roller bearings. Grain wheel, bearing; provision for raising binder at grain wheel.
   d. Bearings—Bearings on counter shaft, crankshaft, roller. Self-aligning or rigid.
   e. Chain—Material used in construction.
   f. Reel—Number slats. Provision for keeping it level.
   g. Transfer trucks—Type, convenience.
   h. Conveniences.
2. Study of binding attachment—
   a. Clutch—Purpose, durability, time works.

b. Trip—Purpose; adjustable, why? Independent of compressor.

c. Compressor—Purposes, adjustment. When is adjustment necessary?

d. Needle—Material used in construction. Is eye reinforced with steel piece?

e. Knotter—The mechanism having to do with the tying of the knot. How driven? How is bill hook driven? Is there a device for stripping the cord from the bill hook? How is twine disc driven? Is knife stationary? Is it easily removed for sharpening?

V. Ensilage Cutters—

1. A comparison of two or three ensilage cutters.

Attempt to study two types. A radical cutter and a cylinder type cutter.

a. Type of Cutter—(radical or cutter head). Size.

b. Adjustments—Is cutter head adjustable, are knives adjustable on cutter head? Is sheer plate adjustable?

c. Knives—Thickness—ease of removing for resharpening. How is length of cut varied?

d. Rollers—Number, width. Will upper roller adapt itself to keep even grasp on material during heavy and light feeding?

e. Blower—Number fans, diameter of blower pipe.

f. Shafting—Diameter of cutter head and lower shaft. Type of bearings, length of bearings.

g. Rated speed—Rated capacity. Power required.

h. Safety appliances.

VI. The Mower.

1. Measure diameter of driving wheel—

Count the number of revolutions of the crank for one revolution of the driving wheel.

How many strokes of the sickle per foot of ground passed over?

Note if pitman is correct length.

At extreme positions of the sickle the sections should be at the center of the guards.

What provision is made to keep cutter bar in alignment with pitman?

Why should provision be made to tip the guards upwards or downwards?

How is the draft applied?
How is it thrown out of gear?
Is it roller or plain bearing?
Has it a vertical lift?
Does the sickle have sliding contact on the ledger plates?
Why is this necessary for good cutting?

VII. The Gasoline Engine. (Select a four cycle engine.)

The student should be provided with several manufacturers' catalogues.

1. Examination of Engine as to horse power and speed—

Study the strokes in order: 1st, charging; 2d, compression; 3d, power; 4th, exhaust.

Why is it called a four cycle engine?
How frequent are the power strokes?

Next examine the ignition. Is it by a jump spark or by a make and break ignitor? Investigate the two systems.

What provision is made to prevent excessive speed?
Is it a throttling or a hit and miss governor?

2. Starting the Engine—

Every engine has its individual peculiarities.

Notice whether it has a relief cock or a starting cam which part of the time holds the exhaust valve from its seat.

A rich mixture is necessary for starting, so throttle the in-going air by means of the damper in the air pipe.

If a starting crank is used be careful not to let it slip on the shaft or be thrown from the hand.

The current for ignition may be supplied by batteries (wet or dry), by a high speed, friction driven direct current magneto or by a slow speed gear driven alternating current low tension magneto which is built-in as part of the engine. This type has no coils or switches and is only used with make and break ignition.

A coil is necessary with batteries or a high speed magneto.

If a jump spark is used the current may be supplied by a high tension magneto as in automobiles, but usually batteries or the high speed friction driven direct current magneto will furnish the spark.

Since different makes of engines have their peculiarities, the directions sent by the makers should be carefully read and the parts identified before attempting to start the engine.

VIII. Farm Structures.

1. Barns—

(a) Visit a lumber yard and learn about stock sizes, grades, and kinds of timber used in your locality, also know how to reduce all sizes to board feet.

(b) Examine different types of barns and if possible compare a heavy timber framed barn with a newer light timber barn. Select some good type of barn and make careful measurements of materials used.

(c) To determine the space necessary for animals. (Members of the class should be assigned specific measurements).

Measure the width of six horse stalls in the neighborhood.

Measure the length of six horses and allowing five feet from the heels to the wall, determine the least possible distance there should be between a manger and the wall. Make the same measurements for cows.

Measure the space (width and length) occupied by different breeds of hens when roosting.

Note the height and width of door required to admit a canopy surrey—Then with ruler and pencil lay out a floor plan of a barn to accommodate some definite number of animals and a surrey.

2. Other Buildings—

First determine the prevailing winds in your locality and place the dwelling house so that it will be free from odors, then with convenience in mind locate the barns, dairy, hog sheds, poultry houses, silos, etc.

IX. Farm Sanitation.

1. Reference:

Iowa Bulletin, "Sewage Disposal For Private Homes."

Wisconsin Bulletin, "Sewage Disposal For Rural Homes."

"Rural Hygiene" by Ogden, Macmillan Pub. Co., New York.

2. The Water Supply.
Pumping Systems.
Storage Systems.
3. Demonstration Exercise—
   a. Planning Water Systems.

4. Plumbing for the country home.
   Lighting, heating, ventilation.
5. Demonstration Exercise—
   a. Planning a Septic Tank and Sewage Disposal System.

X. Farm Drainage. (Demonstration and Practice.)

1. References on Drainage:
   U. S. Farmers Bulletin No. 187 and No. 524.
   Michigan Special Bulletin No. 56.
   Wisconsin Bulletin No. 229.
   "Practical Farm Drainage" by Elliot, pub. by John Wiley & Sons, New York.
2. Equipment—
   One Farmer's Drainage Level.
   One Target, one Surveyor's Tape.
   One Drain Digger's Spade.
   One Dirt Shovel.
   One Drain Scoop or Cleaner.
   One Tile Hook.
   Samples of Drainage Tile.
3. Class and Demonstration Exercises—
   a. Tools and Equipment necessary in Drainage.
      Laying out the Drainage System.
      Leveling and Grading Tile Drains.
      Capacity of Tile Drains.
      Cost of Tile Drainage.
   b. Finding the available fall by use of level.
   c. Digging the ditch. (How to use the various tools to best advantage and digging to the proper grade by use of cross-bars and tight line.)
   d. Laying the Tile (by hand and by tile hook.)
      Priming the Tile.
      Filling the Ditch.

XI. Cement.

1. Construct nine moulds eight inches long, four inches wide and two inches deep. Fill three moulds with a mixture of 1 part cement, 2 parts sand and 25% water. Fill three more with a mixture of 1 part cement, 4 parts sand, 25% water. Fill other three moulds with a mixture of 1 part cement and 1 part sand with 25% water. Allow to remain in the moulds for 48 hours. Wet every day for three weeks; allow to dry for one week and then make a comparative study of the strengths.

2. Other students may use different mixtures and the entire class study the strengths of all the mixtures.

Good mixtures to study are,

Cement. Parts.	Sand. Parts.	Gravel. Parts.
1	1	1
1	2	2
1	2	3
1	2	4
1	3	4
1	3	5
1	3	6
1	3	0

3. Concrete Hog Trough—

Take a common 1 inch by 8 inch board, cut off two pieces each 1 foot long and two pieces each 4 feet long. Nail them together so that they form a sort of box, minus a top and bottom. Do not drive nails clear in as it is necessary that they be easily removed. Place this form on a piece of tin, zinc or any finished surface with a solid foundation.

Mix up a batch of concrete one part cement, two parts sand and three parts gravel with about fifteen per cent water by volume. Place enough in the form to make the bottom of the trough about 1 1/4 inch thick after it is well tamped; now by adding a little concrete at a time mould the sides and ends of the trough. The walls or sides of the trough should be about 1 1/2 inch thick at the top and two inches at the bottom with rounding corners. Go over the walls with a trowel until quite compact. After the concrete has started to stiffen up, which will take about twenty minutes, mix up a batch of neat cement and 50% water, by volume, and plaster the inside of the trough with a coat about an eighth of an inch thick. Smooth this up and allow the trough to set until the next day. Then give it a good soaking with water. On the second day the form may be removed. Wet the trough each day for about two weeks.

In proportioning, consider the amount of gravel the same as the amount of concrete in the finished trough and add the sand and cement in their respective ratios. Mix three times dry and twice wet. If air slacked lime is present the mixture may be benefited by using about 5%.

XII. Section of Sidewalk.

Students should work in groups of four. Each group being expected to put in one section of walk.

1. Establish Grade Line—

Drive grade stakes every 30 feet. Mark stakes showing top line of intended walk.

Stretch a cord between these marks.

Construct forms using 2″ x 4″'s placed edge-ways with the upper edge in line with cord on grade stakes.

Make 2″ x 4″'s solid by driving stakes along the outside of them and nailing fast.

Level off ground inside of forms, and tamp well, so that it is level with the lower edge of the form.

Use 1-2-4 mixture with 20% water for lower three inches or the base of the walk. Tamp until very solid. For the top coat or upper one inch, use a 1-2 mixture with 30% water.

Level off with straight edge so that it is flush with the tops of the forms.

When the top coat begins to "come up" or set it may be finished off with a trowel and divided into sections not more than four feet square. The edges of these may be finished with edgers and groovers.

OUTLINES FOR THE CIVICS AND AMERICAN HISTORY COURSES.

The following outlines were made out by a Committee of the History Section of the Indiana State Teachers' Association, which included: Professor Beverley W. Bond, Jr., Purdue University, Chairman; Miss Beatrice Jones, Evansville High School; Professor F. S. Bogardus, State Normal School; Professor L. H. Gipson, Wabash College, and Mr. Harry W. Wood, Manual Training High School, Indianapolis. The conclusions of the committee were submitted to a number of qualified persons both in Indiana and other States. For their very helpful criticisms, which have been embodied in the final report, the committee is greatly indebted.

The omission of outlines for European History has not been because of the belief that this important subject should be ignored in the Vocational Curriculum. But there is very special need for the adaptation of the usual courses given in Civics and American History to the demands of the Vocational work. The course outlined for Civics is designed to meet the needs of students taking the general course in the Rural High School as well as those who are specializing in Vocational subjects. For American History it would be advisable to organize a special class for students majoring in Vocational work, and the outline has been drawn up with that end in view. Where such a policy is impossible, the outline may easily be modified to the needs of the general course.

In the use of the outlines, careful planning by the teacher is very necessary. All the suggestions cannot be utilized in the time usually given to Civics and American History, and before either course is undertaken there should be a thorough review of the subject by the teacher. The outlines suggest a number of references to aid the teacher in securing the necessary background.

The outlines emphasize the use of a reference library. But to many teachers financial consideration will seem to make impossible the purchase of even the minimum references given. This difficulty can be and has been solved in many schools. Many of the references mentioned in the Civics course can be had for the asking. Again, the State Library offers to lend reference books for a limited time. Details of the conditions, and lists of the books available, can be had by application to the State Library, Indianapolis. Also, many wide-awake teachers, by interesting students and their parents, have collected the necessary funds to secure needed reference

books. Especial attention is called to the work of the Virginia Co-operative Educational Association which in 1912-1913 collected $65,000.00 for various improvements, including libraries, in the rural schools. By addressing the Association at Richmond, Va., bulletins regarding the methods used can be obtained.

In conclusion, the outlines have been prepared in the hope that they will serve as a series of practical working suggestions for the teacher of Civics and American History in the Rural and the Agricultural High School.

BEVERLEY W. BOND, Jr.,

Chairman of Committee on the Correlation of History and Civics with Vocational Courses.

Purdue University, March 29, 1915.

(The following outlines are endorsed by the State Supervisor of Agricultural Education, who frequently consulted with Dr. Bond while the outlines were in preparation.)

OUTLINES OF THE CIVICS COURSE.

STANDPOINT: To secure satisfactory results, it is essential that the teacher grasp, and constantly keep in mind, the aims of the Civics course. The awakening of the pupil's interest in the varied political, economic, and social problems of the day, should be merely a preliminary step in arousing a realization of the duties and responsibilities of the individual citizen. This aim cannot be too greatly accented, for, if it is disregarded, the course will fail to secure really practical results. Nor should the community point of view be disregarded, while the present widespread interest in country life demands that emphasis be laid upon the rural aspect of the problems considered in the Civics course. In short, the course should be practical, not bookish; and political, economic and social, rather than historical. The very importance of the Civics course makes all the more necessary a strict attention to its aims. The majority of the pupils will not continue to the College or University, yet if the real purpose of the Rural High School, to train good citizens as well as good farmers, is realized, the pupils must have an understanding of public questions. This need the Civics course is designed to fill. Probably there should be a separate course in elementary Economics, but this is impossible under existing conditions, and the Civics course must suffice for both government and economics.

COURSE: In mapping out the course the teacher must always consider the preparation of the pupils, the library facilities, and the time devoted to Civics. Usually, instruction in elementary Civics has already been given in the grades, but the library is woefully deficient. The references suggested are cheap and adapted to the purpose, and the time allowed for Civics has already been suggested. Nevertheless, in many cases the detailed suggestions in this pamphlet cannot be fully carried out, and before taking up the course, the teacher should definitely determine just how much work can be done under existing circumstances. In general the Civics course should include two divisions: First, the political; there should be a definite knowledge of the structure and operation of government in its several spheres, local state and national. Special emphasis should be laid upon local, and primarily rural government, a subject which has been altogether too greatly neglected in the schools. Naturally, in a Rural High School, rural government is of special interest to the community, and should therefore be accented. Yet great caution must be employed to give life to this section of the course. Stress should be laid upon the actual operation of the government, rather than upon a mere dry summary of various political powers and theories. Second, the economic and social: The Civics course should include a survey of the chief economic and social problems of interest to the citizen, especially those of rural life. The consideration of these problems, also, should emphasize the practical rather than the merely theoretical standpoint, and this may be done by concrete illustrations, emphasizing always the responsibility of the individual. But while rural problems are to be accented, other broader matters of state or national significance should not be neglected; otherwise the pupil becomes altogether too provincial.

While the Civics course is naturally divided into the two divisions just noted, no attempt has been made in these outlines to mark out a strict distinction between the two. Some authorities may consider an exact division necessary, but it has seemed best to combine the two divisions of Civics throughout the course. Whether this plan shall be strictly followed each teacher must determine with due regard to actual working conditions.

METHOD: Although it is not probable that all of the following suggestions can be utilized, at least a part should prove adaptable to local conditions.

1. The text-book should form the basis of the course, but much discretion must be displayed in its use. Assignments should be pro-

portioned to the relative importance and the difficulty of the topics included. Difficult points should be carefully explained by the teacher, using concrete and contemporary illustrations. The quiz must not degenerate into a mere dry recital of facts but should be designed to keep up the interest, and to bring out practical applications of the topics discussed. Excellent hints for the quiz are given in the text-book; Garner, Government in the United States.

2. The text-book should be supplemented by library work. In assigning this work, it is best to give definite topics and specific assignments. The pupils should also be required to work out an outline of their reference work, or else to write papers, which may be presented to the class, although such reports should not be allowed to encroach upon the time necessary for other parts of the course. Always a well arranged note-book, kept by topics, should be required.

3. In addition to the library references, a limited amount of work may be assigned in charts and maps. The charts are especially valuable for illustrating local government by statistics and comparison. A state map and a county map may be used to illustrate numerous facts, such as the distribution of crops, industries, etc. For a map of Indiana, see the one published by Rand, McNally & Co., 25 cents. From it an enlarged county map can readily be drawn.

4. An excellent aid to the Civics course is a discussion of current topics, either weekly, semi-weekly, or monthly, as time permits. In these discussions the other work of the course should be brought out, and the student should be encouraged to take part. Often a part of this work may be assigned to an individual, as, one pupil may be asked to give a summary of state, another of national legislation. Certainly, the more work the students do for themselves, the more successful will any discussion of current topics prove.

5. Another helpful means to arouse interest is to encourage the formation of debating clubs. The subjects considered should never be mere pedantic questions, but live public problems, preferably of current interest. For example, a proposed new road, the appointment of a new health officer, a new court house, or the proposal for a new state constitution, would be topics of great interest, and incidentally such discussions would be of great aid to the Civics course.

6. Very similar to the debating club is a plan which has been successfully used by many teachers; to organize the class occasionally into a meeting of a political body, such as the County Council, the Advisory Board, the Board of Education, the Circuit Court, the

two houses of the State Legislature or of Congress. By adopting the procedure, and considering the questions likely to come before these bodies, much interest will be aroused and the students will understand the functions of the organizations whose procedure has been adopted.

7. Another expedient to arouse interest is to take some practical problem of local interest and to work it out. Numerous problems may be found such as; the beautification of the school yard, the planting of trees on the roadside, the clearing of fence corners along the roads; in short any problem that will prove of practical value. Such work will teach the "community" spirit, and will arouse the interest and co-operation of parents if it is tactfully undertaken.

8. Another effective means of securing practical civic work is the organization of Boy Scouts or of Junior Civic Leagues. Or else the parents may be included, and Civic Leagues formed, similar to the ones in Virginia which have done so much for the improvement of Rural High Schools. For hints as to the work of such leagues, write the Virginia Co-operative Educational Association, Richmond, Va.

TEXT: The Civics text adopted by the State Board; Garner, Government in the United States, with Davison, Government in Indiana, is used as the basis of the course.

References—

Beside the text-book a good working collection of references is necessary in order to follow out these suggestions. The following is by no means an exhaustive list of references, but it is a practical one and has been chosen with care. The prices are usually net.

I. STATISTICS.

1. Abstract, 13th U. S. Census, with Indiana Supplement. Especially valuable, easily used and should be in every High School Library. Free from Congressman.

2. Biennial Report of Indiana Department of Statistics. This report gives the general statistics necessary to supplement the work on Indiana government. Free from Department of Statistics, Indianapolis.

3. Statesman's Year Book, Macmillan, $3.00, or, 4, American Year Book, Appleton's, $3.00. Of these two, No. 3 is useful for statistics of foreign countries as well as the United States; No. 4 is the more useful and, besides American statistics, contains a wide variety of topics useful in the Civics course.

5. A good almanac, preferably the World Almanac, Press Pub. Co., cloth, 50 cents. The World Almanac, beside statistics, gives a convenient summary of important current legislation.

Whichever of the statistical references is chosen, it is important always to keep on hand the current volume. Back numbers, if preserved, will often serve as useful references.

II. Economics.

1. Burch and Nearing. Elements of Economics. Macmillan, $1.00. One of the best and most comprehensive elementary Economics, and well adapted for reference work in a Rural High School.

2. Carver, Principles of Rural Economics. Ginn & Co., $1.30. Also an important and really an indispensable reference.

3. Fairchild, Rural Wealth and Welfare. Macmillan, $1.30. Though not of recent date this is an interesting and clear presentation of rural economic problems.

4. Gillette, Constructive Rural Sociology. Sturgis & Walton, $2.00. A valuable and practical book, possessing the special merit of presenting the subject from the most recent standpoint.

5. Powell, Co-operation in Agriculture. Macmillan, $1.50. Discusses an important phase of Rural Economics and includes Rural Credits.

III. Political Science.

1. Beard, American Citizenship, Macmillan, $1.00. A thoroughly up-to-date and practical reference, combining the sociological and political point of view in excellent fashion.

2. Debaters' Handbook Series, H. W. Wilson Co. Send for list of this series which is of special value for ready reference. Two numbers of much importance are: Phelps, the Referendum and Initiative, and the Recall, $1.00 each.

3. Dole, The American Citizen. D. C. Heath & Co., 80 cents. A reference of much practical value with a general discussion of economic and political problems.

4. Dunn, The Community and the Citizen. D. C. Heath & Co., 75 cents. A little book specially to be commended as written from the community standpoint, and accenting the duties and obligations of citizenship.

5. Nida, City, State and Nation. Macmillan, 75 cents. A recent book which emphasizes the community point of view, and is written in a simple style. Exceedingly valuable.

6. Van Hise, Conservation of the Natural Resources of the United States. Macmillan, $2.00. A most inspiring and informing book, opening up to the reader a broader horizon.

7. The references given by Garner are valuable, probably the most useful being Bryce, American Commonwealth, abridged edition, revised. Macmillan, $1.75. This reference is heavy and rather difficult except for the more advanced students.

IV. Miscellaneous Aids.

1. The school library should contain—a. A good daily paper, as: The New York Times, daily and Sunday, $8.50; daily $6.00; The Chicago Tribune, library rate daily and Sunday, $6.50, get special rate for daily, only, for library; The Indianapolis News, daily $5.00. b. A good weekly, with a summary of important events as: The Literary Digest, $3.00 with special rate if a number of copies are taken by the class; The Independent, or The Outlook, each $3.00. c. A monthly magazine, treating of current events and topics: The World's Work, or The Review of Reviews, each $3.00.

2. Much excellent material illustrating such subjects as good roads, sanitation, etc., may be found in the set of stereographs or stereopticon slides, for rural high schools, made up by Underwood & Underwood. See list, $17.50 per 100, with 5 per cent. discount to schools. Or else a camera club may take pictures that will be useful for illustration, showing public works, good and bad roads, etc.

3. Many public documents may be secured free through the Congressman from a district, or else for a comparatively small sum from the Superintendent of Public Documents, Washington, D. C. Lists of these documents may be secured from the same address, among the most valuable being: No. 25, Transportation; No. 45, Public Roads; No. 46, Soils and Fertilizers; No. 51, Health, Disease, and Sanitation. Besides these national documents, the reports of various Indiana commissions, usually free, are useful, including: bulletins and reports of the Indiana Board of Health, and bulletins and reports of the Indiana Department of Geology and Natural Resources. These reports may be secured by writing the Commissions at Indianapolis. Another valuable report is that on the Election Law of Indiana, 1910, to be borrowed from the State Library, if it cannot be obtained from the Commission on Elections. Reports of great current importance are those on the Indiana Conferences on Taxation, issued by the University Extension Department of Indiana University. Another important pamphlet is A Study of the People of Indiana and their Occupations for Purposes of

Vocational Education, issued in Indiana University Studies. Write for prices of last two references, University Bookstore.

4. Another valuable adjunct to the Civics course is a collection of illustrative material, such as sample ballots, tax receipts, various legal instruments, copies of state and national laws, city ordinances, reports of various state and local officers. Much of this material can be had for the asking, and for purposes of illustration it will prove invaluable. Newspaper clippings of great interest should also be preserved.

References for the Teacher—The following references are recommended in order to give the teacher the very necessary viewpoint to appreciate the aims of the Civics course, especially as it touches the vital problems of rural life. No. 2 is more recent, practical, and comprehensive, while No. 3 should be carefully read by every teacher of Civics:

1. Butterfield, Chapters on Rural Progress. Univ. of Chicago Press, $1.00.

2. McKeever, Farm Boys and Girls. Macmillan, $1.50.

3. U. S. Bureau of Education, Bulletin No. 41, 1913, 16-22, free from Commissioner of Education, Washington.

4. Uniform Course of Study for High Schools of Indiana, free from Supt. of Education, Indianapolis. In edition for 1914-1915 see Pp. 50-55.

5. Outline for Study of Current Political, Economic and Social Problems. Indiana University Extension Department, University Bookstore, 15 cents.

Necessary References—The following list of library references is the minimum requirement, if the work in Civics is to be really effective. Where a choice is given, the first reference is the preferable one:

1.	Abstract, 13th U. S. Census, free.	
	Biennial Report, Ind. Department of Statistics, free.	
2.	World Almanac	$0 50
3.	Burch & Nearing, Elements of Economics	1 00
4.	Carver, Principles of Rural Economics	1 30
5.	Nida, City, State, and Nation	75
	Dole, American Citizen	80
6.	Dunn, The Community and the Citizen	75
7.	Daily Paper, probably	6 00
8.	Weekly: Literary Digest, Outlook, or Independent	3 00
9.	Monthly: World's Work, or Review of Reviews	3 00
	Total	$16 30

The total cost of these "necessary references," of which the largest item is the daily paper, should not be beyond the means of a rural high school, especially when the real importance of the Civics course, as the one means afforded to train future citizens, is considered.

Outline of Course.

The following order of topics is suggested, the object being to combine general principles of government with the concrete working in Indiana. The teacher's attention is called to the questions for investigation at the end of each chapter in the text.

INTRODUCTORY.

Accent the importance of the Ordinance of 1787, subordinating the historical viewpoint and bringing out the importance of the ordinance in laying the foundations of government. In the same fashion take up the beginnings of government in Indiana.

Text: Davison, 1-8.

Additional Work—Compare the Ordinance of 1787 with the Bill of Rights of the Indiana Constitution, and the first ten amendments of the U. S. Constitution, see Davison, 78-81, and Garner, 407-408. Also note the elementary principles of government.

References—Beard, 3-76; Dole, 3-36; Dunn, 1-33.

LOCAL GOVERNMENT.

Upon this, the phase of government of most importance to the rural community, the chief accent should be laid.

Accent; 1. The county and township system, distinguishing carefully the respective spheres of township and county control.

2. The officers in the township and county should be considered, noting the method of appointment, or election, the duties, and the compensation of each. Make this work as practical as possible, emphasizing the actual duties of the various officials, and their relation to the community.

3. Emphasize the various problems of rural government, especially in connection with the work in Rural Economics, although extended discussion of such topics as Public Education and Sanitation may be postponed to the section devoted to the state government, since it is impossible to distinguish exactly between the work of state and local government in these spheres.

Text: Garner, 5-24; Davison, 9-24.

Additional Work—1. Have a list made of the county and township officers, with names of incumbents, methods of election and appointment, term of office and compensation. See Davison, 9-24 and 77. Much of this work can be done through personal investigation by members of the class.

2. An effective means of arousing interest in local government and its problems is the preparation by the students of an economic survey of the county, which should include total area, farm area, assessment, population, tax levy county and township, detailed receipts and expenditures, indebtedness of the county and purposes for which it was incurred, value of public property, road mileage, improved and unimproved, school statistics including number and grade of schools, number of pupils and teachers, public ditches, charitable institutions, and general farming statistics, including such items as agricultural mortgages and values of the chief crops. Doubtless many items not mentioned in the list will occur to the teacher. If this information is collected and entered in clear fashion upon a large wall chart, it will prove of much practical value in impressing upon the class the importance of the problems of local government. A similar chart may also be prepared for the township.

3. In addition to these charts a table of economic comparisons would be useful, including such statistics as the mileage of improved roads in the township, or county as compared with neighboring townships or counties, farm values before and after road improvement, and various similar comparisons with neighboring townships or counties. Such statistics will form effective illustrations.

4. Another excellent device is the preparation of a county map, which can readily be enlarged from a map of Indiana. This map should show the township lines, the chief settlements, forest and farm areas, roads and public works especially bridges and public ditches, schoolhouses and other public buildings. Other interesting statistics that may be entered upon this may are the acreage in cultivation and the chief crops in each township, and estimates of the various crops, land values, and any other statistics that are available for each township.

The necessary material for these charts and maps can be secured from the Abstract of the 13th U. S. Census with Indiana Supplement, from the Biennial Report of the Indiana Department of Statistics, from the reports of the Indiana Department of Geology and Conservation, and from published reports of County Auditors and

Town Trustees. Much of this information can also be secured by personal investigation by members of the class. For detailed and valuable suggestions regarding such a survey, see Gillette, 281-292.

Rural Economics—The work in Rural Economics should be taken up in connection with that on rural government. The two subjects are inseparable; just how far they shall be combined, and how much time shall be devoted to this part of the Civics course, each teacher must decide with a view to varying local conditions. Yet caution must be observed to prevent too great an emphasis upon this part of the course, to the exclusion of problems of city, state and national government. To be well informed, the student must have some knowledge of these latter important subjects, even though the accent is placed upon the former. Make the work in Rural Economics as practical as possible and try wherever possible to give concrete illustrations of the theories given in the reference work. An exceedingly suggestive outline for Rural Economics and Sociology is given by Butterfield, 226-232. The following suggested list of topical references has been adapted from this outline:

References—

1. General Characteristics of the Agricultural Industry: Carver, 1-28; Fairchild, 1-19; Gillette, 57-76; Powell, 3-17.

2. Agricultural Conservation: Carver, 117-202; Fairchild, 27-31; Gillette, 77-89.

3. Farm Management: Carver, 224-239 and 315-333; Fairchild, 38-62; Gillette, 90-98; Powell, 250-270.

4. Small vs. Large-Scale Farming: Carver, 239-256; Gillette, 123-130.

5. Rural Labor Problems: Carver, 290-296; Fairchild, 32-37; Gillette, 137-146.

6. Land Tenure: Carver, 226-234 and 296-305; Dunn, 43-53; Gillette, 130-137.

7. Rural Credits: Powell, 271-298.

8. Agricultural Marketing:
   a. General: Fairchild, 63-100; Gillette, 98-103.
   b. Co-operative: Powell, 120-149; Gillette, 103-109.

9. Farmers' Organizations: Carver, 369-382; Gillette, 200-216; Powell, 18-19.

10. Rural Communication, including roads, telephones, rural mail routes, and electric railways: Dunn, 103-108; Fairchild, 22-24; Gillette, 110-122; Nida, 233-242; Powell, 299, 307.

11. Rural Social Problems:
    a. General: Carver, 334-343 and 360-369; Gillette, 168-199.
    b. The Rural Church: Carver, 343-359; Gillette, 217-232.
    c. The Rural School: Carver, 359-360; Gillette, 233-263.
    d. Rural Government: Dunn, 189-197; Nida, 215-218.
    e. Rural Sanitation: Gillette, 146-167.

TOWN AND CITY GOVERNMENT.

Too much time should not be devoted to this part of the Civics course. The various municipal problems should be considered, especially those of importance to Indiana. Emphasize the mutual relations between the city or town and the county in which it is situated.

Text: Garner, 25-56; Davison, 25-40.

Additional Work—Little reference work can be done on municipal problems. Statistics for the chief town or city in the county may be worked out upon the plan proposed for the county and township. This chart would include population, assessment, detailed receipts and expenditures, indebtedness, with a special note of the objects for which it was incurred, and statistics of fire protection, police, health, and industrial interests. For material for this chart see Abstract 13th U. S. Census, Indiana Supplement; Biennial Report of Ind. Dept. of Statistics; and annual report of the city controller. But, however interesting this work may be, too much time cannot be given to it at the expense of the more important work in rural government.

Where time permits, there should be an intensive survey of the chief municipal problems, to supplement the text. Rural pupils should at least understand these problems, as they may come in intimate contact with them in the future. The following topical references are suggested:

1. City Planning and Housing, Beard, 261-263; Nida, 1-23 and 78-86.
2. City Sanitation, Beard, 253-261; Nida, 24-30, 51-72 and 96-102.
3. Water Supply, Nida, 31-50.
4. Municipal Transportation, Beard, 253-255; Nida, 103-119.
5. Municipal Highways, Beard, 252-253; Nida, 73-77 and 120-137.
6. Public Recreation and Institutions, Beard, 263-265; Nida, 138-164.

7. Fire Protection, Beard, 251-252; Nida, 165-187.

8. Municipal Finance, Beard, 266-267; Nida, 188-197.

9. Municipal Government, accenting recent proposed reforms, Beard, 130-139 and 242-251; Dole, 72-77; Dunn, 198-207; Nida, 198-210.

STATE GOVERNMENT.

First accent the respective spheres of state and local, state and national government. In the latter it will be necessary to anticipate somewhat, but a clear and exact distinction must be made between the two. Emphasize the viewpoint that each individual, as a citizen, has a vital interest in all three forms of government. Another important point is the use of the text. Let the section on Indiana government illustrate specifically the general principles of government in the State. For example, the general section on the Legislature, Garner, 73-90, should be directly followed by the specific legislative powers and organization of Indiana (see Davison, 41-45). The same method should be employed for the Executive and the Judiciary. See also the Constitution of Indiana, Davison, 78-100. The following topics should be accented:

1. Legislative: Note the method of election and the powers of the two houses. The organization, the procedure, the importance of the personnel of the Legislature are important topics. Here, too, the question of the Referendum and the Initiative should be considered. Emphasize the actual procedure and organization of the legislature, explaining the importance of committees, and the party caucus. An excellent device is to study, through the newspapers, the actual progress of a bill through the legislature. This method will effectively explain actual legislative procedure.

2. Executive: The chief officers of the State, the method of election or appointment, the tenure of office, the salaries, and the duties, should be noted (see Davison, 77 and 87-91). The question of the Recall is also to be considered here. Emphasize the importance of the personality of the executive in determining the actual results. By concrete examples, the power of these officials for good or evil can be illustrated and impressed upon the class.

3. Judicial: The different courts, and their procedure, should be emphasized. This is especially true of the concrete organization in Indiana (see Davison, 71-76). The average citizen has little conception of the organization of the judiciary. See Davison, 77 and 91-93.

Text: Garner, 57-124; Davison, 41-76.

Additional Work—General Problems of the State Government. Among the chief problems to be considered is the state system of taxation. Take this up from the practical point of view, including amount, and also specific expenditures. This is perhaps the fittest place to take up the general theory of taxation as applied to local, state, and national government. This problem should be thoroughly considered and in a practical fashion. Accent the conception of all citizens as stockholders interested in public affairs. Nowhere can the responsibility of the individual citizen be better impressed. An excellent method is to compare the system of taxation and statistics for Indiana with those of other states. See especially, in addition to the general references, the World Almanac or the American Year Book. The reports of the Indiana State Conference on Taxation should be secured, and the defects of the system carefully noted. The national system of taxation should not be stressed here, leaving such consideration to the section devoted to the national revenue.

Closely connected with the subject of taxation is that of state aid to education. Indeed the general subject of public education may be considered here. Accent the state aid to Indiana University, Purdue University, and the State Normal School. Also note the aid given to Agricultural courses under the new Vocational Law. The teacher should impress upon the class the purpose of such state expenditures, to promote good citizenship, as well as mere education, and the corresponding obligation of the recipient. Show the pupils the cost to the taxpayers, each day, of the education they are receiving.

Other state problems include public health, aid to institutions for defectives and criminals, the work of the various state commissions. Note also the problem of Civil Service. If possible, a general chart of state statistics might be prepared, similar to the one suggested for local government. This would include area, assessed value, population, tax levy, detailed receipts and expenditures, and state property. Such a chart will do much to awaken interest while also impressing the class with the numerous activities and the importance of the state government. See also Indiana University Studies, Study of People of Indiana and Their Occupations, etc.

An economic map of the state may also be prepared, similar to the one proposed for the county. A Rand-McNally map can be used, the various statistics inserted, and the industrial areas properly shaded.

References—

General, Beard, 121-129 and 219-241; Abstract, 13th U. S. Census, with Indiana Supplement; Biennial Report Indiana Department of Statistics; reports of State Auditor, and various commissions and departments. For comparisons, use the World Almanac or the American Year Book. These last references contain also a summary of important current legislation. In addition the following specific references are recommended:

Taxation, Burch & Nearing, 248-254; Dole 94-102; Dunn, 228-238; Reports of State Conferences on Taxation.

Public Education, Beard, 225-227; Dole, 103-107; Dunn, 118-131.

Public Health, Beard, 227-234; Dole, 24-30; Dunn, 54-66; Bulletins and Reports of Indiana Board of Health.

Civil Service, Dole, 108-116; Dunn, 178-205.

Initiative, Referendum, and Recall, Dunn, 208-217; Beard, 161-168; Phelps, The Initiative and Referendum, and The Recall.

POLITICAL PARTIES AND THE SUFFRAGE.

Here, too, local and national systems cannot be separated. Hence the question of political parties and the suffrage must be considered from both points of view. Note the conditions of the suffrage in Indiana. Practical problems of methods of conducting elections are worked out in Garner, and stress should be laid upon this part of the text. Show the reason for political parties, their practical working, their evils and their benefits. Impress upon the student the importance of considering the personal fitness of the candidate, and show that, in local politics, personality, rather than mere party affiliation should be considered. This part of the Civics course can be made of great practical value. The aim should be, to give the class a clear conception of present practices, of the various reforms proposed, and of the benefits of each one. Especially should the individual responsibility of the citizen be accented. In short, the work should be concrete rather than theoretical. By using newspaper clippings and by frequent references to current events, this result may be secured.

Text: Garner, 125-158; Davison 38-39 and 81-82.

Additional Work—Have each student make out an outline of the registration requirements, and the method of conducting elections in Indiana. An excellent device is to have the class work out the election of some official, for example, the township trustee.

The method of nomination, the registration of the voters, and the final election should all be carefully studied. A great aid in this work will be the pamphlets on the Indiana Election Law. Personal observation, a sample ballot, and newspaper clippings will furnish whatever supplementary material is required.

References—Beard, 145-169, 220-221 and 287-297; Dole, 116-165; Dunn, 161-188; Nida, 248-257 and 304-307.

THE NATIONAL GOVERNMENT.

The text takes up the national government in an effective fashion, and can be followed. The suggestions in the Research Questions are good and also the references given. In this section of the course the teacher frequently fails to hold the student's attention by giving merely a long and dry summary of different powers. If frequent illustrations are given from current events, and also many practical applications are made, this difficulty will be obviated.

Text: Garner, 159-392.

Additional Work—National Economic Questions—Frequent allusions are made by the text to economic questions of national importance, and it has been considered best to give references on such questions. The teacher must decide just how much economic theory may be given, and where. The available references, the time devoted to the Civics course, and the general intelligence of the class, will guide in the solution of this problem of practical teaching.

Among the numerous national economic problems that may be considered are Banking and Currency, Business Organization, the Trusts, Conservation, Immigration and Labor Problems, the Tariff, Transportation, especially the problems of railroad rates and the work of the Interstate Commerce Commission, general economic theory, and proposed reforms, as Socialism. Always have the class understand the theoretical basis of the problem under discussion. An aid in securing this result will be to bring forward as many concrete illustrations as possible from current newspapers. Then, too, try to show the actual effect of these questions upon the life of the citizen. For example, how the tariff is supposed to affect business, and the positive effect of railroad rates in building up, or tearing down the business of a community. For general statistics see, Abstract, 13th. U. S. Census; World Almanac; and American Year Book.

General Reference—Beard, 79-120 and 173-218.

Specific References—Banking and Currency; Beard, 209-215; Burch & Nearing, 222-239; Dole, 199-212; Fairchild, 109-179; World Almanac, 1914, for details of the Federal Reserve Act.

Business Organization; Beard, 177-192; Burch & Nearing, 158-191; Fairchild, 191-213, and 224-231.

Conservation, Burch & Nearing, 45-77; Dunn, 98-102; Van Hise, 106-151 and 185-358.

Immigration and Labor, Beard, 195-197; Burch & Nearing, 78-119; Dunn, 34-42; Fairchild, 32-37, 45-57, 180-223 and 239-278.

Tariff, Beard, 183-187; Burch & Nearing, 240-247; Fairchild, 213-223.

Transportation, Beard, 180-181; Burch & Nearing, 189-205; Fairchild, 109-114.

Special: Burch & Nearing, 255-303, is excellent for economic theory, while 304-355 gives a synopsis of the various solutions proposed for economic problems. Dole, 169-253, has a good discussion of economic duties, and 257-315 of social rights and duties. Both these sections are suggestive and practical, yet the book suffers from the need of a thorough revision to be abreast of modern economic thought. Fairchild, 233-305 on Distribution, and 307-371 on Consumption is good, combining the theoretical and the practical, but this book, though more recent than Dole, also suffers from need of a revision.

Outlines of the American History Course.

Standpoint—Like the Civics, the American History course, as usually given in the rural high schools, should be modified to meet present conditions. In framing this course, it is important to bear in mind the foundations laid by the study of American History in the grades. Avoiding a mere amplified repetition of this work, the High School course should accent the economic, and social forces that underlie and explain the course of political history. The geographical background should also receive attention, while in a rural high school the agricultural influences that have so greatly aided in shaping American History should be accented. But agricultural and other economic forces should not be the only topics noticed, for the pupil in the rural, as well as in the city high school should catch the inspiration and patriotic impulse that comes from the idealistic standpoint of history. The purely cultural side of the course should not be neglected, and the pupils'

interest should be so aroused that they will voluntarily undertake further historical reading after leaving the high school. To combine all these different standpoints in the short time allotted to the history course seems a well-nigh superhuman task. Yet by experience the teacher will gradually learn the time that may be given to each portion of the course.

Method—The demands of the course will naturally determine the method, which should be partly topical, although precaution must be taken to avoid a fragmentary discussion of topics which fails to show the interaction of forces and the place of each national problem in the history of the United States. For general purposes, the text-book adopted by the State Board, James & Sanford, American History, must form the basis. As specific topics are taken up in the text they should be accented and amplified by reference and map work.

In the actual course, assignments of the text should be proportioned to the importance and the difficulty of the topics that are being considered. Mere daily doses of so many pages of history are to be avoided. In assigning library work, the pupils should be given specific topics and exact references. Full notes should be taken on all this work, and perhaps occasional essays may be assigned. The quiz should bring out the important points in both the text and reference work, and when time permits, reports of the latter may be made to the class. Much care must also be used to prevent the quiz from degenerating into a dry recital of facts. Much oral explanation is necessary in order to bring out the causes and results of important events in the narrative. Careful directions should also be given for keeping note-books. They should always be arranged topically, and all map-work should be placed beside work on the same topic. Such an arrangement will be found especially useful for review.

The following references will be found of great help to the teacher in preparing for the course: Bourne, Teaching of History and Civics, 283-309 and 325-352, Longman's, $1.50; McKinley, Illustrated Topics for American History, McKinley Publishing Co., 82 cents; Uniform Course of Study for High Schools of Indiana, 39-50, free; Cornman & Gerson, Topical Survey of U. S. History, D. C. Heath & Co., 60 cents.

References and Aids for the Class—The following list is by no means exhaustive. The aim has been rather to include only such references as are reasonable in price and are suited to the course, and to give a practical, rather than an exhaustive list. In addi-

tion, the text gives excellent lists of references at the end of each chapter. In choosing further books on American History for the school library, such references should be selected as are likely to produce a cultural interest in historical reading. The works of Parkman and Fiske, and good biographies are recommended. Books of this type are to be preferred to the more elaborate histories, such as Schouler, McMaster, etc. While these latter serve an excellent purpose, the former are more desirable where, as is usually the case, the resources of the library do not permit the purchase of both types. The "Essential References and Aids" recommended are necessary in order properly to carry on the work. The total price, $17.85, is certainly not large, in view of the results that can be attained if even this minimum of references is employed. Where a choice is given, the first is the mere preferable.

Necessary Aids and References—

1. Bassett, Short History of the United States, Macmillan $2 50
2. Semple, American History and Its Geographic Conditions, Houghton 1 60
3. Bogart, Economic History of the United States, Longman's 1 75
   Coman, Industrial History of the United States, Macmillan 1 60
4. James, Readings in American History, Scribner's... 1 50
   Caldwell & Persinger, Source Book of the U. S., Ainsworth 1 25
   Hart, Source Book of American History, The Macmillan Co. 60
5. Harding, New Med. and Mod. History, Am. Book Co. 1 50
   Robinson, Introduction to the History of Western Europe, Ginn. 1 60
6. McKinley, Illustrated Topics for Am. History, 2c each, and twenty topics recommended for class of 15, @ 30 for 50c 5 00
   McKinley, Desk Outline Maps, 20 for 15c; for class of 15 ..... 2 25
   Both of above references published by McKinley Publishing Co.
7. A good wall map of the United States; recommended, Columbia Series, Rand, McNally 4 00

Total $17 85

Other References—

1. Carver, Principles of Rural Economics, especially good for the rural background, Ginn & Co., $1.30.

2. Cheyney, Introduction to the Industrial and Social History of England, essential for the English background of American History, Macmillan, $1.40.

3. Cheyney, European Background of American History; a fine reference for the purpose. Readable and interesting. Harper's, $2.00.

4. Drake, The Making of the Great West, and The Making of the Ohio Valley; the latter is specially recommended. Scribner's, $1.50 each.

5. Home University Library, Henry Holt & Co., 50 cents each. The following numbers are specially recommended: Andrews, The Colonial Period; McDonald, From Jefferson to Lincoln; Paxton, The Civil War; Haworth, Reconstruction and Union. These little books are very useful and afford excellent and readable summaries of the periods they cover.

6. Readings in Indiana History; valuable for Indiana History as giving the local touch that invariably arouses interest. Should be in every Indiana school library. University Bookstore, 70 cents.

7. Moore, Industrial History of the American People. This reference is especially good for the rise of American Agriculture and its influence upon national development. Macmillan, $1.25. An accompanying Teacher's Manual, 20 cents.

8. Old South Leaflets (see list), Old South Association, 5 cents each; annual subscription, 50 cents.

9. Prothero, English Farming, Past and Present. Rather an expensive book, but one that helps to explain early colonial life, giving the English setting. Doubtless it would prove useful in other courses, beside American History, in the Rural High School. Longman's, $4.00.

10. Robinson, Commercial Geography. An interesting and useful book with a broad point of view. Rand, McNally, $1.25.

11. Brigham, Geographic Influences in American History. The historical standpoint is not well worked out, but the book is suggestive and useful. Ginn & Co., $1.25.

12. Van Hise, Conservation of the Resources of the United States. Excellent for the physical background and the insight into present day problems. Macmillan, $2.00.

For a more extended list of references see:

1. Andrews, Gambrill & Tall, A Bibliography of History for

Schools and Libraries, 85-154; discriminating and practical. Longman's, 60 cents.

2. Bourne, Teaching of History and Civics (edition 1910), 283-285. To be used with much discretion as many of the references are not suited for high school work. Longman's, $1.50.

3. Indiana Uniform Course of Study for High Schools, 166-167. Practical and usable. Free.

Other Aids—

1. The list of stereographs, or steropticon slides, made up by Underwood & Underwood will prove of much value in the History course. The list of 100 for agricultural high schools will prove of special value. They may be supplemented by the list of 100 for general high school purposes. Underwood & Underwood, $17.50 per 100 with school discount of 5 per cent.

2. Sanford, American History Maps. This is probably the best series of maps for use in the American History course. If it is impossible to secure the entire set of thirty-two, separate maps may be purchased (see list). The map on Conservation and the West, No. 30, is of special value. A. J. Nystrom & Co. For the set of 32 maps, $24.00. Singly, $1.40 each.

3. Another valuable map is Johnston's Blackboard Map of the United States, Imperial Series. This map may be used many times and to illustrate many special topics. For detailed suggestions, see special pamphlet. A. J. Nystrom & Co., $3.25 per map.

4. Another valuable aid in illustrating especially the geographical influences in American History, is a good, physical map of the United States. The map recommended is, Physical Series, map of the United States, Rand, McNally, $4.50.

Outlines.

The following division of topics is recommended as an outline for the course in American History. It may perhaps be criticized as involving more work than the time usually allowed for this course will permit. Moreover, to follow closely the outline would require library work beyond the facilities of the average high school. Undoubtedly both criticisms are valid, and the choice of topics that can be actually worked out must be left to the individual teacher, the conditions in each case determining just how much of the outline can be followed. If it is impossible to cover the entire course thoroughly, the colonial period may be passed over hastily, and emphasis should be placed upon the period since 1789. Again,

while all the topics given are considered important, if a choice must be made, the accent should be placed upon the Formation of the Constitution; Westward Expansion, especially in the settlement of the Ohio Valley; the economic and political influences that brought about the Civil War; and the problems of National development since 1865.

THE COLONIAL PERIOD, 1607–1766.

In taking up the Colonial Period, use great care not to become bewildered in a mass of historical details. The development of self-government, the economic and social forces at work, and the gradual extension of British territorial claims, should be considered.

1. The Physical Background of American History.

This subject should have special accent, as the physical contour, the climate, and the natural resources have determined in large measure the economic and political development of the American people.

Topics—

1. Physical conditions that have developed distinct sections:
   a. The Eastern Seaboard:
      1. New England predominantly commercial.
      2. Middle States commercial and agricultural.
      3. Southern States predominantly agricultural.
   b. The Central Plain, predominantly agricultural.
   c. The Rocky Mt. Pleateau, predominantly mining and grazing.
   d. The Pacific Slope, predominantly horticultural.
2. Influence of physical features upon discoveries and place of early settlements.
3. Influence of Means of Communication:
   a. In directing settlement along river valleys.
   b. In determining the location of cities.

Maps and Outlines—McKinley, Illustrated Topics, U. 1. On accompanying map, show the principal physical features, and the main economic areas of the United States; or else use McKinley, Desk Outline Map, No. 175.

References—Bassett, 1-13; Bogart, 1-16; Brigham, 1-199; Coman, 4-7; Robinson, Commercial Geography, 98-105; Van Hise, 266-277.

II. European Background.

Note the European background, especially as determining the type of colonists that came to America. Note that the characteristics of the colonists in connection with the physical features of their environment chiefly determined future history. If time must be saved, this section and No. III may be reviewed briefly, since both subjects have already been taken up in the grades.

Topics—

1. European political, religious and economic conditions that influenced colonization.
2. Industrial conditions of rural England in the latter part of the sixteenth and in the seventeenth centuries.
3. A brief review of French and Dutch industrial conditions at this time.
4. The chief motives for colonization.

Text: James & Sanford, 1-8.

Outline: McKinley, Illustrated Topics, U. 3.

References—Bassett, 23-27; Carver, 48-63; Cheyney, European Background, especially 3-78; Cheyney, Indus. and Soc. England, 136-198; Harding, 299-430; Prothero, 78-129; Robinson, Western Europe, 321-350 and 495-508; Sparks, 17-24.

III. Period of Discovery.

Accent here the geographical importance of the discoveries that laid the foundations for future rivalries in America of the European nations.

Topics—

1. The most important voyages and the motives for them.
2. The chief Spanish and French explorations in the Mississippi Valley.
3. The regions claimed by France, England, and Spain.
4. The bases of these claims.

Text: James & Sanford, 8-36.

Map: On McKinley, Illustrated Topics, U 9, use the map to show the routes of the chief Spanish and French explorations in the St. Lawrence and Mississippi Valleys, or else use McKinley, Desk Outline Map, 177.

References—Bassett, 27-40; Drake, Great West, 1-28 and 71-109; Drake, Ohio Valley, 3-15; Semple, 19-35; Sparks, 25-35.

Source-Book. James, 1-35; Hart, 1-17; Caldwell & Persinger, 2-17.

IV. Period of Settlement.

Beside the regular class-work, in this and the preceding sections, constantly refer to the map on the class-room wall.

Topics—

1. Chief early settlements along the Atlantic Seaboard.
2. Political rights and government of the early colonists.
3. Industrial and social life in the early colonies, especially the types of agriculture.
4. The Dutch and Swedish colonies, showing the importance of their conquest by Great Britain.

Text: James & Sanford, 37-84.

Maps and Outlines: McKinley, Illustrated Topics, U 6, Nos. 1-3; U 7, Nos. 1-6; U 8, Nos. 1-6. The map work may be given in connection with each topic, or else use McKinley, Desk Outline Map, No. 177. Indicate each important area of settlement, the territorial claims of each colony under its charter, and the strategic situation of the Dutch and Swedish colonies.

References—Andrews, 9-61; Bassett, 41-88 and 109-110; Bogart, 17-35; Brigham, 1-16, 37-56 and 70-74; Semple, 1-18; Sparks, 36-47.

Source-Book: James, 36-66; Hart, 18-73; Caldwell & Persinger, 17-52.

V. French and Indian Wars.

In this section of the course it is important that the student fully appreciate the early history of the Mississippi Valley and its bearing upon the later development of this region.

Topics—

1. French settlements in the St. Lawrence Valley and at the mouth of the Mississippi.
2. The chain of forts projected between the two areas of French settlement.
3. British emigration to the Trans-Alleghany region.
4. The resulting struggle between British and French for the Mississippi Valley.
5. Aid given the British in the struggle by their Indian allies.
6. The final results of the struggle:
   a. In asserting British control over the St. Lawrence and the Mississippi Valleys.
   b. In bringing about attempts at more effective control of the colonies.

Text: James & Sanford, 104-127.

Maps and Outlines: McKinley, Illustrated Topics, U 9, No. 2. Use the accompanying map to illustrate the main French settlements, and also the territorial adjustments made by the Treaty of Utrecht, 1713, and the Treaty of Paris, 1763. Or else show these points on McKinley, Desk Outline Map, No. 177.

References—Bassett, 111-132; Brigham, 104-127 and 142-155; Coman, 8-21; Harding, 453-462; Drake, Great West, 109-131 and 132-139; Drake, Ohio Valley, 16-90; Sparks, 69-77.

Source-Book: James, 78-105; Indiana Readings, 18-45; Hart, 96-107; Caldwell & Persinger, 123-146.

VI. Development of Colonial Self-Government.

Do not fail to remind the class that the colonists did not knowingly prepare for independence, and that the colonies formed an integral part of the British Empire. Conditions arose which made it necessary to adapt their institutions to the government of an independent country.

Topics—

1. Colonial political institutions.
2. Development of British colonial policy.
3. Emphasize such struggles as Bacon's Rebellion and the Andres Revolution, as steps in securing a larger measure of colonial self-government.
4. The steps leading to colonial union and the causes.

Text: James & Sanford, 85-91 and 133-141.

Outlines: McKinley, Illustrated Topics; U 7, Nos. 7 and 8; U 12, Nos. 6 and 7.

References—Andrews, 107-228; Bassett, 88-108; Bogart, 90-104; Moore, 209-255.

Source-Book: James, 67-77; Hart, 124-136; Caldwell & Persinger, 53-99 and 146-164.

VII. Colonial Economic, Social, and Intellectual Development.

While this section of the course is an exceedingly interesting one, it should not be too greatly emphasized at the expense of more important topics. Generally, this section should be considered in order to afford a background for the proper understanding of colonial life. Such a treatment will explain many of the problems

of the revolutionary and transitional period and of the early period under the Constitution.

Topics—

1. General agricultural conditions and land tenure.
2. Industrial conditions, especially the economic, as well political, dependence of the colonies upon England.
3. The inadequacy of transportation facilities.
4. Colonial economic problems:
   a. Financial.
   b. Abundance of raw material allowing great growth of population, and no need for conservation.
   c. Labor problems; servants and slaves.
5. The development of small farms and commerce in the North, of the plantation system in the South, and general results.
6. Chief colonial products, agricultural, and others.
7. Colonial trade with: (a) England; (b) West Indies; (c) Intercolonial.
8. Religious tendencies and political effects.
9. Education, and general intellectual conditions.

Text: James & Sanford, 91-103 and 128-133.

References—Andrews, 62-106; Bassett, 134-158; Bogart, 36-89; Brigham, 30-36, 48-69 and 72-90; Carver, 63-70; Coman, 22-88; Moore, 1-208, 256-257 and 439-448; Prothero, 130-206; Robinson, Commercial Geography, 104-106; Semple, 36-51; Sparks, 48-68.

Outlines: McKinley, Illustrated Topics, U 6, No. 4; U 7, No. 9; U 8, No. 7; U 12, Nos. 1, 5 and 8.

Source-Book: Caldwell & Persinger, 99-123; Hart 74-95 and 108-123; James, 106-125.

REVOLUTIONARY AND TRANSITIONARY PERIOD, 1766-1789.

While this is the heroic period of American history, for the purposes of this course it should not be too greatly emphasized. The two main topics are the causes and results of the Revolution and the evolution of the Constitution. The details of the narrative should be brought out merely to give the background of these main topics. The narrative has already been considered in the grades.

I. The Revolution.

Topics—

1. Causes:
   a. Policy of stronger colonial control by the British government.
   b. Navigation laws and their attempted enforcement.
   c. The Stamp Act.
   d. The Townshend Acts.
   e. Coercion Acts of 1774.
2. French aid.
3. Revolutionary finance.
4. Final results:
   a. Gave political independence to Seaboard colonies.
   b. Gave theoretical, but not actual possession of Trans-Alleghany region.
5. Trans-Alleghany emigration, especially to Kentucky and Tennessee. Its importance in holding this region for the United States.

Text: James & Sanford, 142-182.

Map and Outline: McKinley, Illustrated Topics, U 13; use McKinley, Desk Outline Map, No. 175, to show the American, British, and Spanish Territory after the Peace Treaty of 1783.

References—Andrews, 229-252; Bassett, 161-219; Bogart, 105-113; Coman, 89-122; Drake, Ohio Valley, 94-139.

Source-Book: Caldwell & Persinger, 166-232; Hart, 137-160; James, 126-163.

II. Transitional Period.

Topics—

1. Articles of Confederation and their defects.
2. The Ordinance of 1787 should be accented as:
   a. Establishing the foundations of government in this region.
   b. Setting a precedent for the national policy toward other territories.
   c. Promoting westward emigration by the guarantee of rights.
3. Steps leading to the Constitutional Convention.
4. The Constitution, especially the three great compromises; note that the Constitution was really an adaptation of governmental principles, already known, to new conditions.
5. The adoption of the Constitution with the development, in

the struggle, of the germs of future parties; note the theory of the centralized and of the loose form of government.

Text: James & Sanford, 183-214.

Map and Outlines: McKinley, Illustrated Topics U 16; on McKinley, Desk Outline Map, No. 177, show the territory organized by the Ordinance of 1787; see Semple 52-74, for the main routes followed in the emigration to the Trans-Alleghany region.

References—Bassett, 222-254; Bogart, 113-117; Coman, 123-133 and 156-164; Carver, 74-81; Drake, Great West, 162-168; Drake, Ohio Valley, 139-161 and 255-262; Semple, 52-92; Sparks, 78-87.

Source-Book: Caldwell & Persinger, 233-245 and 266-284; Hart, 161-180; James, 164-207; Indiana Readings, 47-103.

THE ESTABLISHMENT OF THE NATIONAL GOVERNMENT, 1789-1814.

I. Founding the Government, 1789-1803.

In this period note the important precedents that were set, and also the tests put to the real strength of the National Government.

Topics—

1. Hamilton's Financial Policy.
2. The Whiskey Rebellion; to be considered from the constitutional, as well as the agricultural and economic standpoint.
3. The Alien and Sedition Laws, and the Virginia and Kentucky Resolutions.
4. Gradual development of the party of strict, and the one of loose construction of the Constitution.
5. Foreign relations, especially with France and England.

Text: James & Sanford, 215-245.

References—Bassett, 256-296; Bogart, 117-118 and 148-161; Coman, 133-156 and 164-170; Moore, 349-356 and 392-400; Semple, 75-92; Sparks, 159-187.

Source-Book: Caldwell & Persinger, 245-264 and 285-309; Hart, 181-200; James, 208-258.

II. The Louisiana Purchase.

Topics—

1. Review the beginnings of Kentucky and Tennessee.
2. The European background of the Louisiana Purchase, and the motives of Napoleon in making the sale.

3. Actual territory acquired.

4. Results: a, in holding the Trans-Alleghany states to the Union; b, in developing the United States into a Continental power.

5. Impetus given to exploration in the Far West, and the chief expeditions.

6. General effect upon foreign relations.

Text: James & Sanford, 245-249.

Map and Outline: McKinley, Illustrated Topics, U 19; use the accompanying map to show the territory acquired by the Louisiana Purchase, or else use McKinley, Desk Outline Map, No. 175.

References—Bassett, 296-300; Brigham, 182-184; Coman, 170-174; Drake, Great West, 171-223; Drake, Ohio Valley, 161-213; Harding, 527; Robinson, Commercial Geography, 106-108; Semple, 93-113; Sparks, 88-103 and 188-210.

Source-Book: Caldwell & Persinger, 310-316; Hart, 200-202 and 206-209; James, 258-265.

III. The War of 1812.

Emphasize the fact that this war was for economic, as the Revolution was for political, independence. Also, it settled the possession by the United States of the Mississippi Valley.

Topics—

1. Economic independence of the United States upon England.

2. The European Background; the struggle between England and France.

3. The Embargo and Non-intercourse policy.

4. The Question of Impressment.

5. The Western posts and the Indian Wars, especially the Battle of Tippecanoe.

6. Pass over in short review the military features of the war, but accent the prestige gained the United States in: a. The naval campaigns; b. The Battle of New Orleans.

7. The attitude of New England, culminating in the Hartford Convention.

Text—James & Sanford, 249-270.

References—Bassett, 300-338; Bogart, 120-132; Drake, Ohio Valley, 214-228; Harding, 514-566; Moore, 267-272; Semple, 114-149.

Source-Book: Caldwell & Persinger, 317-333; Hart, 202-205 and 209-223; Indiana Readings, 103-146; James, 272-296.

PERIOD OF DEVELOPMENT, 1814-1865.

I. Reorganization, Westward Movement, and Internal Improvements, 1815-1825.

The chapter is one of the utmost importance, and should be emphasized. Especially should the geographical background of the opening up of the West be carefully considered. The Missouri Compromise naturally brings up the general subject of slavery, and is a most important topic considering specially its effect upon future events.

Topics—

1. Economic Reorganization:
   a. Tariff of 1816 marks the beginning of a protective policy; note the results in the growth of manufactures.
   b. Charter of the 2d U. S. bank.
   c. Panic of 1819; its causes and results.
2. Westward Immigration and Internal Improvements:
   a. The importance of internal improvements in providing means of communication.
   b. The geographical conditions determining routes of travel of the Westward Migration, and areas of settlement.
   c. Development of the Public Land System.
   d. General characteristics of early pioneer life.
   e. Accent the early settlement of the Ohio Valley, and pioneer life in Indiana.
3. Missouri Compromise:
   a. Growth of slavery.
   b. Settlement of Missouri, which brought up question of slave vs. free labor.
   c. Compromise significant, as marking off free from slave territory.

Text: James & Sanford, 270-284.

Map and Outline: McKinley, Illustrated Topics, U 21, No. 6, and U 23. Use the map accompanying U 23 to illustrate the Missouri Compromise, showing the region under territorial government, and the extent of free and slave soil. Or else use McKinley, Desk Outline Map, No. 175.

References—Bassett, 341-346, 350-357, 363-368 and 371-375; Bogart, 135-147, 162-173, and 189-204; Brigham, 106-190; Coman, 175-194 and 203-206; Drake, Great West, 223-233; Drake, Ohio

Valley, 229-254; McDonald, 7-34 and 35-38; Semple, 150-168; Sparks, 104-158 and 220-269.

Source-Book: Caldwell & Persinger, 334-341 and 344-346; Hart, 226-241; Indiana Readings, 147-170; James, 297-330.

II. Development of Nationalism, 1815-1830.

In taking up this chapter, the teacher should impress upon the class the growing power, at this time, of the Federal government, and the result in developing a national, as contrasted with a merely state, patriotism. Bring out also the influences tending in the opposite direction, toward the assertion of state's rights.

Topics —

1. Influences favoring Nationalism:
    a. Development of the doctrine of implied powers by the Supreme Court.
    b. Purchase of Florida.
    c. The Monroe Doctrine;
        1. The European background.
        2. Far-reaching results in defining American foreign policy.
2. Influences favoring State's Rights:
    a. The dispute with Georgia.
    b. The Tariff of 1828;
        1. The sectionalism of the tariff.
        2. The opposition of South Carolina and the cause of this attitude.
3. The elections of 1824 and 1828.

Text: James & Sanford, 285-296.

Outline: McKinley, Illustrated Topics, U 21, Nos. 1-5, 7, and 9-10.

References—Bassett, 357-360, 368-371, 375-377 and 377-391; McDonald, 34-35 and 39-46; Harding, 570-571; Sparks, 211-219.

Source-Book: Caldwell & Persinger, 342-344 and 346-353; James, 330-334.

III. The New Democracy and the Rise of Sectionalism, 1830-1845.

Topics—

1. Influence of the West, as signalized in the Jacksonian era.
2. The protective tariff and the Nullification controversy.
3. Gradual growth of the abolition movement.

4. Increasing divergence between a free labor, commercial North, and a slave-holding, agricultural South.

5. The Bank controversy and its results.

6. Centralized government vs. State's Rights.

Text: James & Sanford, 297-326.

References—Bassett, 384-388, 392-419, and 422-438; Bogart, 237-250; Coman, 198-203, 227-231, and 269-278; Moore 324-327 and 356-360; McDonald, 46-81, 227-231 and 269-278.

Source-Book: Caldwell & Persinger, 353-378; Hart, 242-268; James, 334-351 and 405-410.

IV. The Mexican War and Territorial Expansion, 1845-1850.

Topics—

1. The annexation of Texas, leading to the Mexican War.

2. Pass over the military operations of the Mexican War briefly and accent the territorial results.

3. The Oregon Compromise.

4. Summarize the chief additions of territory, 1803-1860.

5. The settlement of California and the Overland trails.

Text: James & Sanford, 322-333.

Map and Outline: McKinley, Illustrated Topics, U 29, Nos. 1-9; show on accompanying map the territorial acquisitions by the Mexican War, and the Oregon Compromise, also the chief Overland trails to the Pacific coast; or else use for this work, McKinley, Desk Outline Map, No. 175.

References—Bassett, 419-422 and 438-453; Bogart, 296-297; Brigham, 186-187 and 230-310; Coman, 243-248; Drake, Great West, 28-71, 143-147, 149-162 and 233-289; McDonald, 82-123; Semple, 168-177 and 226-245; Sparks, 301-350.

Source-Book: Caldwell & Persinger, 398-406; Hart, 268-270; James, 388-405.

V. Economic, Intellectual, and Social Progress, 1814-1861.

Before taking up the several steps that led to the Civil War, there should be a more or less extended review of economic, intellectual, and social progress up to this point. The pupil should have a thorough understanding of these conditions, in order to appreciate the real forces that brought on the War. Especially in the Rural High School, the following topics deserve a thorough consideration. The extent of this work, however, must depend upon the available library references.

Topics—

1. Improvements in transportation, and
2. Resulting spread of agricultural interests.
3. General advance in agricultural methods, making possible: a, a larger production; b, an increased population.
4. Small farms of the North and West, and large plantations of the South.
5. Free labor in the North and West; slave labor in the South.
6. Immigration went to West and North, and not to South; result in promoting "national" spirit in the West.
7. North predominantly commercial; Middle States commercial and agricultural; West agricultural; South agricultural.
8. Internal improvements.
9. General industrial and commercial advance.
10. Intellectual advance.
11. Development of public education.

Text: James & Sanford, 273-281, 292-303, 341-343 and 353-359.

Outlines: McKinley, Illustrated Topics, U 21, Nos. 8 and 11; U 28, and U 31, Nos. 1-3.

References—Bessett, 461-484; Bogart, 176-188, 205-236 and 251-255; Brigham, 187-193; Coman, 207-227, 232-243 and 248-278; Carver, 82-92; Moore, 299-316, 327-328, 400-421 and 448-468; Robinson, Commercial Geography, 105-169; Semple, 178-225, 246-279 and 367-391; Sparks, 270-300 and 376-418.

Source-Book: Caldwell & Persinger, 379-396 and 433-451; Indiana Readings, 171-378; James, 351-387 and 411-426.

VI. Steps Leading to the Civil War, 1850-1860.

This period should not receive too much attention. The interest is chiefly political. Emphasize the political significance of the Civil War, and the events that led up to it.

Topics—

1. Compromise of 1850.
2. Kansas-Nebraska Act.
3. Dred Scott Decision.
4. The Kansas Struggle.
5. The John Brown Raid.
6. The Rise of the Republican Party.
7. The election of 1860.

Text: James & Sanford, 333-367.

Map and Outline: McKinley, Illustrated Topics, U 29, No. 10; and U 30; show on map accompanying U 30 the sectional divisions of the Election of 1860, or else use McKinley, Desk Outline Map, No. 175.

References—Bassett, 454-458 and 485-510; Coman, 278-279; Drake, Great West, 290-314; McDonald, 124-250; Sparks, 351-365.

Source-Book: Caldwell & Persinger, 407-433; Hart, 279-296; Indiana Readings, 379-406; James, 426-433.

VII. The Civil War, 1860-1865.

Do not dwell upon the military details of the campaigns, but rather explain the geographic conditions and the lines of transportation that determined the chief military operations. Also take up, in broad outline, the important military plans and campaigns.

Topics—

1. Accent the factors that decided the outcome of the Civil War:
   a. The respective strength of the North and South in men.
   b. The industrial and other economic resources of North and South.
   c. The lack of manufactures in the South and the consequent dependence upon foreign trade.
   d. The resulting effectiveness of a blockade in crushing the South.
2. The chief military features of the War may be noticed:
   a. The South on the defensive.
   b. Plans of offense and defense as determined by geographical conditions.
   c. Opening Mississippi River and breaking of Southern lines of defense in Western campaigns.
   d. The series of campaigns to take Richmond.
   e. Aggressive campaigns by the South in East and West, and failure.
3. Foreign relations during the Civil War, especially with England.
4. Finances of the War: a, Union finances, including the issue of legal tender and the founding of the National Bank System; b. Confederate finance.

5. The problem of securing sufficient troops.

6. Opposition to the War in North and South; the open hostility to President Lincoln shown in the North.

7. The Emancipation Proclamation and the Thirteenth Amendment.

Text: James & Sanford, 368-414.

Map and Outlines: McKinley, Illustrated Topics, U 31, No. 41; U 33; use the map accompanying U 33 to show the seceding and the border States, or else use McKinley, Desk Outline Map, No. 175.

References—Bassett, 511-593; Bogart, 385-388; Brigham, 200-229; Coman, 279-288; Moore, 360-368 and 421-428; Paxson, 11-61 and 61-248; Semple, 280-319.

Source-Book: Caldwell & Persinger, 451-465; Hart, 296-335; Indiana Readings, 407-438; James, 444-448.

PERIOD OF NATIONAL DEVELOPMENT, 1865 TO THE PRESENT.

The period of recent history should be emphasized. Too often the course ends without an adequate presentation of contemporary problems of national importance, leaving the student with a vague impression that American History is a rather imaginary narrative of almost forgotten events. The logical development of our present conditions from the past must be accented to obviate such an impression. If this is done, the reality of the past, and its effect upon the present will be emphasized and impressed. The dominant topics of this period are: the repair of the ravages of the War, and the rise of the South; the development of the central government, now firmly established; and national expansion.

I. Reconstruction and Expansion, 1865-1880.

Topics—

1. The theories and problems of Reconstruction, noting:
   a. Lincoln's plan.
   b. Johnson's plan.
   c. The radical plan of Congressional Reconstruction.
   d. The era of Carpetbagger government.
2. Fourteenth and Fifteenth Amendments.
3. The acquisition of Alaska.

4. The expansion of the West:
   a. The Homestead Act and its influence in settling up the West.
   b. The Pacific railroads, opening up the Far West.
   c. Influence of increased transportation facilities in widening markets and enlarging production.
5. The great advance in agricultural and industrial interests.
6. Financial situation:
   a. Panic of 1873.
   b. Resumption of specie payments.
   c. Free Silver Movement.

Text: James & Sanford, 415-459.

Map and Outline: McKinley, Illustrated Topics, U 35; on accompanying map show the chief transcontinental lines, and the main areas of settlement in the Far West by 1880. Or else use McKinley, Desk Outline Map No. 175.

References—Bassett, 594-706; Bogart, 306-326, 348-361, 388-397 and 407-423; Coman, 288-307; Carver, 92-108; Drake, Great West, 140-142 and 315-320; Haworth, 7-101; Moore, 339-342 and 468-473; Robinson, Commercial Geography, 170-195; Semple, 319-336 and 391-396; Sparks, 366-375 and 429-438.

Source-Book: Caldwell & Persinger, 465-484; Hart, 336-363; Indiana Readings, 439-444; James, 489-513.

II. Political Changes and Industrial Expansion, 1880-1890.

Topics—

1. Political situation, the "Solid South."
2. Civil Service Reform.
3. The Interstate Commerce Commission.
4. Tariff policy: a, question of protection; b, political aspect.
5. Pan-American movement.
6. Anti-trust legislation.
7. Indian policy.
8. Improved transportation facilities in South and West.

Text: James & Sanford, 460-476.

Outline: McKinley, Illustrated Topics, U 36.

References—Bassett, 707-727; Bogart, 397-400; Coman, 313-316; Haworth, 101-135.

Source-Book: Hart, 363-372; James, 514-526.

III. Industrial and Political Problems, 1890-1897.

Topics—

1. The rise of the Populist party.
2. The Free Silver Movement at its height.
3. Annexation of Hawaii.
4. The Venezuelan question.
5. International arbitration.
6. Protective tariff policy.
7. Woman's Educational and Economic Advance.
8. General Educational Advance.
9. Industrial advance, especially important inventions.
10. General agricultural advance, accenting progress in scientific and diversified farming.

Text: James & Sanford, 477-496.

References—Bassett, 727-730 and 746-781; Coman, 316-322; Moore, 380-382; Haworth, 135-174.

IV. Imperialism, 1898-1914.

Upon this and the following section much emphasis should be placed. Such a treatment would bring the development of the American nation down to the present day, and also would serve to give an understanding of national problems.

Topics—

1. Spanish-American War, from the standpoint of cause and effect.
2. Territories annexed as a result of the Spanish-American War.
3. Colonial policy, especially in the Phillipines.
4. The Panama Canal.
5. The Monroe Doctrine as applied at present; and our general foreign policy.

Text: James & Sanford, 497-516.

Map and Outlines: McKinley, Illustrated Topics, U 38; and U 39, No. 8; On McKinley Desk Outline Map, No. 100, show the United States with all outlying territories, including the Panama Canal strip.

References—Bassett, 782-828; Haworth, 174-194 and 219-223; Robinson, Commercial Geography, 210-242; Semple, 397-435; Sparks, 439-452.

Source-Book: Hart, 373-392; James, 526-532.

V. Internal Growth and Present Economic Problems, 1898-1914.

In discussing the varied economic problems of the present, consider them from the historical and practical, rather than from the economic and theoretical standpoint. The latter should be taken up in the Civics course.

Topics—

1. The industrial rise of the South.
2. The wiping out of sectional differences between North and South.
3. Government aid to agricultural education.
4. Recent advances in agriculture.
5. Development of Alaska.
6. National conservation; especially of forests and water power; also public mineral lands.
7. Immigration and Labor Problems.
8. Control of trusts.
9. Control of Railways and the Interstate Commerce Commission.
10. Tariff policy.
11. Development of a merchant marine.
12. National defense.
13. Recent banking legislation.

Text: James & Sanford, 516-526.

Outline: McKinley, Illustrated Topics, U 39, Nos. 1-7 and 9-13.

References—Bassett, 829-852; Bogart, 327-347, 362-384, 397-401 and 424-539; Coman, 307-312, 322-335 and 341-413; Carver, 108-116; Haworth, 195-219 and 223-245; Moore, 272-298, 317-324, 328-339, 342-348, 368-389, 428-438 and 473-491; Robinson, Commercial Geography, 196-209; Semple, 337-366; Sparks, 419-428; Brigham, 193-199 and 310-355.

Source Book: Indiana Readings, 444-450; James 533-581.

ADDRESSES OF PUBLISHERS OF REFERENCES FOR CIVICS AND AMERICAN HISTORY.

Ainsworth & Co., 378-388 Wabash Ave., Chicago.
D. Appleton & Co., 533 S. Wabash Ave., Chicago.
American Book Co., 1104 S. Wabash Ave., Chicago.
The Century Co., Union Square, New York.
Ginn & Co., 2301-2311 Prairie Ave., Chicago.
Harper & Bros., Franklin Square, New York.
D. C. Heath & Co., 623 S. Wabash Ave., Chicago.
Henry Holt & Co., 34 W. 33d St., New York.
Houghton-Mifflin Co., 623 S Wabash Ave., Chicago.
Longmans, Green & Co., 443-449 4th Ave., New York.
The Macmillan Co., 66 Fifth Ave., New York.
McKinley Publishing Co., Philadelphia.
A. J. Nystrom & Co., 623 S. Wabash Ave., Chicago.
Old South Association, Old South Meeting House, Washington St., Boston.
Oxford University Press, 35 W. Thirty-second St., New York.
Press Publishing Co., Pulitzer Building, New York.
Rand–McNally & Co., Rand–McNally Building, Chicago.
Scott, Foresman & Co., 623 S. Wabash Ave., Chicago.
Chas. Scribner's Sons, 597 Fifth Ave., New York.
Sturgis & Walton, 31-33 E. Twenty-seventh St., New York.
Underwood & Underwood, 12-14 W. Thirty-seventh St., New York.
University Bookstore, Bloomington, Ind.
University of Chicago Press, Chicago.
H. W. Wilson Co., White Plains, N. Y.

PERIODICALS AND NEWSPAPERS.

Chicago Tribune, Chicago.
The Independent, 119 W. Fortieth St., New York.
Indianapolis News, News Building, Indianapolis.
Literary Digest, Funk & Wagnalls, 354-360 Fourth Ave., New York.
New York Times, Times Square, N. Y.
Outlook, The Outlook Co., 287 Fourth Ave., New York.
Review of Reviews, Review of Reviews Co., 30 Irving Place, New York.
World's Work, Doubleday, Page & Co., 11-13 W. Thirty-second St., New York.

AGRICULTURAL REFERENCE BOOKS.

For Seventh and Eighth Grades and High Schools.

SOILS.

Soil and Soil Fertility, Whitson and Walster. Webb Publishing Co., St. Paul, Minn..... $1 25
First Principles of Soil Fertility, Vivian. Orange Judd Co., New York..... 1 00
Fertilizers and Crops, VanSlyke. Orange Judd Co..... 2 50
Farm Manures, Thorne. Orange Judd Co..... 1 50
Land Drainage, King. Macmillan..... 1 50
Purdue Publications—
Extension Bulletin No. 31. (Available in quantities for class use.)

CROPS.

Field Crops, Wilson and Warburton. Webb Publishing Co., St. Paul, Minn..... $1 50
Field Crop Production, Livingston. Macmillan Co., Chicago 1 40
Corn Crops, Montgomery. Macmillan..... 1 60
New Creations in Plant Life, Harwood. Macmillan..... 1 75
Forage Crops and Their Culture, Piper. Macmillan..... 1 75
Cereal Crops, Carleton. Macmillan.
U. S. Dept. of Agriculture, Farmers' Bulletin No. 640.
Purdue Extension Bulletin No. 30. (Available in quantities for class use.)

ANIMAL HUSBANDRY.

Diseases of Animals, Mayo. Macmillan Co..... $1 50
Sheep Farming, Craig. Macmillan..... 1 50
Animal Husbandry, for Schools, Harper. Macmillan..... 1 40
Beginnings in Animal Husbandry, Plumb. Webb Publishing Co.....
Types and Breeds of Livestock, Plumb. Ginn & Co..... 2 50
Feeds and Feeding, Henry. W. A. Henry, Madison, Wis... 2 25
U. S. Dept. of Agr., B. A. S., Bulletin No. 37, Market Classes of Horses.
U. S. Dept. of Agr., F. B. No. 170, Principles of Horse Feeding.

DAIRYING.

A. "The Business of Dairying," Lane. Orange Judd Co., New York $1 25
B. "Principle and Practice of Buttermaking," McKay & Larson. John Wiley & Sons, New York 1 50
C. "Dairy Cattle and Milk Production," Eckles. Macmillan Co., Chicago 1 60
D. "Feeds and Feeding," Henry. W. A. Henry, Madison, Wis. 2 25
E. "Types and Breeds of Farm Animals," Plumb. Ginn & Company, Chicago 2 00
F. "Breeding Farm Animals," Marshall. Sanders Pub. Co., Chicago 1 50
G. "Diseases of Animals," Mayo. Macmillan Co., Chicago 1 50
H. "Dairy Farming," Michels. John Michels, Raleigh, N. C. 1 00
I. "Milk and Dairy Products," Barthel. Macmillan Company, Chicago 1 90
J. "Milk and Its Products," Wing. Macmillan Company, Chicago 1 50
K. "Testing Milk," Farrington & Woll. Mendota Book Co., Madison, Wis. 1 25
L. "Market Dairying and Milk Products," Michels. John Michels, Raleigh, N. C. 1 50
M. "Production and Handling of Clean Milk," Winston. W. R. Jenkins Co., New York 3 25

POULTRY.

Purdue Extension Bulletin No. 10.
Purdue Extension Bulletin No. 40.
Report of Bureau of Statistics, State House, Indianapolis.
U. S. Dept. of Agr., Farmers Bulletin No. 642.
U. S. Dept. of Agr., Dept. of Chem., Cir. No. 61, Washington, D. C.
U. S. Dept. of Agr., Farmers Bulletin No. 530, Washington, D. C.
Poultry Production, by Lippincott. Lea and Febiger, Philadelphia.
Productive Poultry Husbandry, by H. R. Lewis. J. B. Lippincott Company, Philadelphia $2 00
Principles and Practice of Poultry Culture, by John H. Robinson. Ginn & Company, Chicago 2 50
American Standard of Perfection. Reliable Poultry Publishing Company, Quincy, Ill. 2 00
U. S. Dept. of Agr., Farmers Bulletin Nos. 141, 517, 160, 585, 630.

HORTICULTURE.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Most of these publications, including all "Farmers Bulletins," may be obtained free of charge, by making application through a congressman or United States Senator. For some of the publications of the various Bureaus a small price is charged, usually between five and fifteen cents. To purchase federal publications remittance should be made to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Farmers Bulletins—

Title.	Number.
Asparagus Culture	Bulletin 61
Beans	Bulletin 289
Cabbage	Bulletin 433
Cucumbers	Bulletin 254
Potato Culture	Bulletin 35
Tomatoes	Bulletin 220
Celery	Bulletin 282
Diseases of Cabbage and related Crops	Bulletin 488
The Liming of Soils	Bulletin 77
Frames as a Factor in Truck Growing	Bulletin 460
Use of Windmills in Irrigation	Bulletin 394
Marketing Farm Products	Bulletin 62
Canning Vegetables in the Home	Bulletin 359
Canning Tomatoes at Home and in Clubs	Bulletin 521

Bureau of Entomology—

Title.	Number.
Striped Cucumber Beetle	Circular 31
Common Squash Bug	Circular 39
Root Maggots and How to Control Them	Circular 63
Colorado Potato Beetle	Circular 87

Year Book Separates—

Title.	Number.
Insects Injurious to Onions	594—1912

Year Books—

Title.	Year.
A Successful Method of Marketing Vegetable Products	1912

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF COMMERCE AND LABOR.

To secure these publications address either a congressman or United States Senator or the Superintendent of Documents, Government Printing Office, Washington, D. C.

Bureau of the Census.

Abstract of the 13th Census 1910, with Supplement for Indiana.

The prices given below are the list prices. Many publishers make discounts of varying amounts from list price for school libraries.

Asparagus, Hexamer. Orange Judd Co.	$0 50
Bean Culture, Sevay. Orange Judd Co.	50
Cabbages, Cauliflowers, etc., Allen. Orange Judd Co.	50
Cyclopedia of American Horticulture, Bailey. Macmillan Company	20 00
Fertilizers and Crops, VanSlyke. Orange Judd Co.	2 50
Garden Farming, Corbett. Ginn & Co.	2 00
How Crops Feed, Johnson. Webb Pub. Co.	1 50
Insects Injurious to Vegetables, Chitenden. Orange Judd Company	1 50
Insect Pests of Farm, Orchard and Garden, Sanderson. Wiley & Sons.	3 00
Melon Culture, Troop. Orange Judd Co.	50
New Rhubarb Culture, Morse. Orange Judd Co.	50
Principles of Vegetable Gardening, Bailey. Macmillan Co.	1 50
Success in Market Gardening, Rawson. Doubleday, Page Company	1 10
Tomato Culture, Tracy. Orange Judd Co.	50
Vegetable Gardening, Watts. Orange Judd Co.	1 75
Vegetable Gardening, Green. Webb Pub. Co.	1 00
Diseases of Economic Plants, Stevens and Hall. Macmillan Co., Chicago.	2 00
Injurious Insects, O'Kane. Macmillan Co., Chicago, Ill.	2 00
The Principles of Fruit Growing, Bailey. Macmillan.	1 50
Bush Fruit, Card. Macmillan.	1 50
Productive Orcharding, Sears. Lippincott Pub. Co., Chicago, Ill.	1 50
Pruning Book, Bailey. Macmillan.	1 50
Purdue Bulletin, Vegetable Gardening, No. 171.	

FARM MECHANICS.

Agricultural Engineering, Davidson. Webb Pub. Co.
U. S. Dept. of Agr., Farmers' Bulletin No. 638.
Wisconsin Bulletin, "Knotting and Splicing," by Hasluck. David McKay, Publisher, Philadelphia.
Farm Machinery and Farm Motors, by Davidson and Chase. Webb Pub. Co.

LISTS OF APPARATUS.

Apparatus and Material for High Schools—Soils.

Common Use—

1.	Torsion balance	$25 00
2.	Soil sieve—12 mesh—18" D	75
3.	Drying oven, galvanized	5 00
4.	Miscellaneous chemicals	2 00

For each student—

5.	Tripod lens	50
6.	Glass tumblers (6)	30
7.	Glass funnels 4" mouth (4)	40
8.	Large spoon	10
9.	Tin pans 2 qt., (2)	30
10.	Galvanized troughs 8" x 1" (8)	80
11.	Tin cans—1 qt., (18)	40
12.	2" D. glass tubes, 15" long (6)	1 50
13.	Beer bottles, 1 qt., for percolation (6)	15
14.	Rack for holding apparatus, material	1 00
15.	Muslin, 1 yard	07

Apparatus and Equipment for Seventh and Eighth Grades—Soils.

Needed for each student except balance.

1.	Tripod lens	$0 50 .
2.	Spring balance	50 or
3.	Torsion balance	25 00
4.	Tin cans (1 qt. tomato) 1 doz	20
5.	Litmus (blue) 1 box	25
6.	Glass tumblers (4)	20
7.	Tin pans (1 qt.) (4)	20
8.	Tin pans (2 qt.) (4)	60
9.	Lamp chimneys (8)	80 or
	12" glass tube 2" D. (8)	2 00
10.	Erlenmeyer flasks 500 cc. (2)	30
11.	Flower pots or straight-sided 1 gal. jars (2)	40

Apparatus for High School Crops.

1.	Tape line (press button)	$0 10
2.	Foot rule	05
3.	Tripod lens	50
4.	Torsion balance	25 00
5.	Metric scale	25
6.	Testing bucket	15 00
7.	Dinner plates for seed testing 2 sizes—4 for each student	20
8.	Muslin, 1 yard per student	07
9.	Grains, etc., according to students	

Note: It is possible to do without the torsion balance and testing bucket.

Students should furnish their own tape line, rule, lens and metric scale.

Apparatus for Seventh and Eighth Grade Crops.

1.	Tape line (press buttons)	$0 10
2.	Rule (1) foot	05
3.	Weed Seed collection (Purdue)	25
4.	Metric scale	25
5.	Tripod	50
6.	Testing box	25
7.	Bottles, widemouthed, 16 oz. 6	30
8.	Seed samples	

Equipment for Work in Horticulture.

Pruning Tools.

Saws—

E. C. Atkins—Indianapolis:
No. 4—6 teeth to inch.

Henry Desston & Sons—Philadelphia:
D 26–24″—6 teeth to inch.
No. 7½ Sears—type—24″—6 teeth to inch.
York State Pruner—6 teeth to inch.

Hand Shears—

Henry Dreer Company—Philadelphia:
Perfection shears—9″.

Topping Shears—

Carroll Tiffany—Franklin Forks, Pa.:
All steel shear.

Pole Shear—

Common telegraph pruner—any hardware store.

Spray Outfit.

Good barrel pump, such as:
Morrill & Mirley, Benton Harbor, Mich.:
Eclipse No. 6.
Deming Pump Co., Salem, Ohio:
Sampson.
Gould Pump Co., Chicago:
Pomona.

1—10 foot bamboo extension rod—fitted with leaklers cut-off
1 lead—50 feet by ½-inch high pressure hose—long shank couplings.
Hardie Mfg. Co.—Hudson, Mich.
Hayes Pump Co.—Calva, Ill.

Nozzles—either—
Niagara Anglid Aluminum.
Scientific Niagara Sprayer Co., Middleport, N. Y.:
Friend Mfg. Co., Casport, N. Y.
"Friend" Anglid Nozzle.

Equipment for Dairying in the Grades and in High School.

I. Demonstration showing the composition of one gallon of milk.
   a. 1-1 gallon bottle for milk.
   b. 1-gallon bottle for water.
   c. 1 bottle containing 5.5 ounces of butterfat.
   d. 1 bottle containing 6.6 ounces of milk sugar.
   e. 1 bottle containing .69 ounces of albumen.
   f. 1 bottle containing 4.1 ounces of casein.
   g. 1 bottle containing .96 ounces of ash.

II. Map of Europe to be used in locating the native home of the various breeds of cattle.

III. One-half dozen 1-quart Mason fruit jars to be used in demonstrating the ensiling of crops.

IV. Two dozen 1-pint Mason fruit jars to be used in displaying feed samples.

V. One standard cream cooling outfit.

VI. One hooded milking pail.

VII. One Babcock Testing outfit consisting of:
  a. One Babcock tester, 4 to 8 bottles.
  b. One dozen 8% milk bottles.
  c. 3—16.6 c.c. pipettes.
  d. 2—16.5 c.c. acid measures.
  e. 1 pair dividers.
  f. Concentrated sulphuric acid.
  g. 1 dozen cream test bottles, 50%, short neck.
  h. 1 pair cream scales sensitive to 1/10 grams.

VIII. Three 1-pint glass stoppered milk sample bottles.

IX. 1—30 pound milk scales.

X. Information in regard to type of equipment, method of construction, materials for charts, bulletins, photographs, etc., may be obtained through the Dairy Department, Purdue University.

MANUFACTURERS AND DISTRIBUTERS OF AGRICULTURAL APPARATUS.

Central Scientific Company, Chicago.
Columbia School Supply Co., Indianapolis.
Kiger & Company, Indianapolis.
Industrial Education Company, Indianapolis.